FOOD TECHNOLOGY

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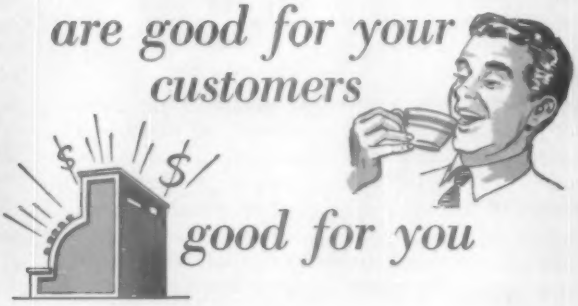

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FEATURING THIS MONTH . . .

Indiana IFT Section Stages a High School Career Day

S. J. Davin
Technical Sales, Wm. J. Stange Co. of Chicago

SCIENTIFIC MANPOWER SHORTAGE! These are "worry" words. They appear every now and then in the discussions of food technologists. Effort has been made to do something about the situation—for example, the IFT careers brochure. But in addition to the printed word, the spoken word is needed. For this reason, the Indiana section, a militant group of food technologists, thought it was time to get some high school students together and give food technology top priority in the field of sciences by means of direct contact—talking across the table. An executive meeting was called on June 21, 1956, and the mechanics of a "High School Career Day Program" in conjunction with one of their seasonal meetings was set forth. From then on, things happened.

Getting under way

Shortage of quality control and laboratory personnel in meat packing plants, canning plants, and other food processing plants has made this high school career program a *must* in the Indiana area as in others. At the outset of the program, various members were assigned to contact the vocational directors or guidance counselors of the dozen Indianapolis high schools and to report back to the executive committee (Figure 1).

Figure 1. Indiana Section Executive Committee that sparked the Career Day—Left to right, front row: Ruminger (Chairman), Winslow, Rutledge, Taylor, Verna McCallum. Left to right, rear row: Ekermeyer, Davin, and Havens.

In the meantime a local newspaper was enlisted to give statewide publicity to the campaign. Fortunately, Joseph K. Shepard, a food enthusiast, was given the assignment for the Indianapolis *Star*. His article appeared in the rotogravure magazine section of the Sunday edition, December 30, 1956; and went out to 350,000 subscribers. The article covered three full pages and was packed with action pictures showing section members in high school laboratories mixing with students and counselors. In Mr. Shepard's interesting article, "There is Adventure in Food", the past, present and future of man's search for more and better food are discussed. "The unplowed fields in food science stretch to the horizons, and there are too few to turn the virgin earth. There is an acute shortage of food technologists. Indiana is taking the lead in a student conference idea that may help to close the ranks in a yet-unrecruited army of folk who will take a portion of their pay, at least, in unexpressed thanks of the world at a time when all of us will have forgotten how it happened. It probably will set a pattern for similar meetings throughout the United States, a far-seeing plan to keep things going on an ever-accelerating vista as great as anything science-fiction ever dreamed up—including trips to the moon. Just to keep up the research already under way will absorb 15,000 skilled people a year. Our colleges are not turning them out. Perhaps this high school career program fostered by these food technologists may interest some Hoosier pupil to press one of the organ keys in tomorrow's great concerto of life." So reads the enthusiastic salute to the Indiana Section's project.

No primrose path

An apathetic condition was reported among most of the schools, partially due to lack of knowledge and understanding of food technology. Some schools mentioned that parental approval in writing was necessary. Written consent was necessary before students were allowed to be photographed. If the meeting involved high schools outside of the city limits, the state board of high schools committee would have to be summoned at a special meeting to give their consent. Transportation of the students to the meeting was necessary. Mention of this resistance is made in order to inform other sections contemplating a similar program that all is not simple and easy and automatic in this business of putting on a "career day". Much footwork and pressuring the guidance directors of the High Schools by the section members brought final approval, however, and on January 8, 1957, the executive committee met at Butler College for the final meeting. In the meantime we established a cash prize for an essay on "Food Technology as a Career". This seemed to spur on some of the teachers and guidance directors and is recommended as worthwhile.

The day arrives

On January 12, 1957, sixty students registered to participate in the essay contest and attend the meeting. Ten high school counselors and forty section members met with the students at Rice Auditorium, Medical Building of Indiana University, Indianapolis, Indiana (Figure 2). The meeting was called to order by Indiana Section Chairman Al Ruminger at 10 A.M. During the next six hours, the high school students and

(Continued on page 4)

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(Continued from page 2)

the audience were bombarded with factual information about college education in general and the food field in particular. It was apparent that they liked it and that the message got across.

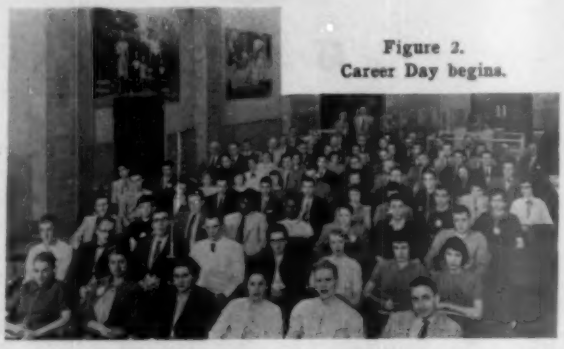

Figure 2. Career Day begins.

A run-down of events can begin with Dr. Gale Ammerman, Food Technologist from Purdue University (Figure 3), who read a paper entitled "Education for a Career in the Food Industry—The Giant Industry". He discussed the value of college education from the standpoint of developing a whole, happy, well-adjusted person who can contribute to the society that but for him might not endure. Dr. George F. Garnatz, Director of Kroger's Food Foundation (Figure 3), and National President of IFT, discussed his 30 years of experience in Food Technology. He stated that no other profession equals the food field in offering opportunities for making worthwhile contributions to society. Dr. Garnatz pointed out the fact that Food Technology is a young profession filled with excellent chances for the well trained individual to gain recognition. Dr. I. J. Hutchings, H. J. Heinz Company (also Figure 3), presented a paper on the giant food

Figure 3. IFT President George Garnatz, far right, with Dr. I. J. Hutchings, Research Director, Heinz and Co., center, and Dr. Gale Ammerman, left, Purdue University food technologist.

industry under the title "Nowhere in the Professional World Is There a Greater Challenge or a Greater Opportunity Than What Food Technology Offers Today for the Person with an Alert, Inventive Mind". Dr. Hutchings presented a complete résumé of food processing from plant breeding for production of better crops through all phases of preservation. He stressed training in bacteriology and other basic sciences as important foundational factors in a career in the food sciences and technologies.

Several excellent films such as "The Big Kitchen",

(Continued on page 6)

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(Continued from page 4)

"Three Squares", and "The Maine Sardine" were also shown to round out an excellent program.

Representatives from Purdue University, Michigan State University, and Illinois University, were present to discuss their Food Technology programs with prospective candidates for a B.S. Degree in Food Technology. The fact that a great deal of interest in Food Technology has been aroused in the high school students was evidenced by the fact that representatives at all the universities were kept busy answering questions throughout the counseling sessions (Figure 4).

Figure 4. Dr. Reid Milner, Head, Food Technology Department, University of Illinois, one of the counsellors from colleges of the area, answers a question posed by prospective food technology careerists.

Aftermath

Dr. Garnatz was extremely pleased with the idea of the High School Career Program and urged the Indiana Section to make this meeting an annual affair. The executive committee of the Indiana Section stated it intends to do so. By establishing scholarships and by other devices interest can be made continuous.

Our May 6th meeting will reveal the winner of the essay contest. National President-elect Dr. Emil M. Mrak from the University of California will be invited to present the winner with the prize. Copies of the essay will be available at the Pittsburgh Convention.

If other state sections plan a similar project, they may be interested to know that the whole program, dining the students and guests, photographers, etc., cost the Indiana Section less than two hundred dollars. Additional information on this successful pioneer effort may be had by contacting Miss Verna McCallum, Section Secretary at Stokely-Van Camp—941 North Meridian, Indianapolis, Indiana.

The Indiana Section takes pride in its accomplishment and considers that it has not only done something about the scientific manpower shortage but also has done something about the scientific manpower shortage in the food field. It also believes that it has done something for the high school student pondering a career. And a career in food technology can be satisfying to the individual, important to our economy, and vital to our survival in a day when the present margin between population and the food supply begins to shrink.

IFT ACTIONS AND REACTIONS . . .

"NO SERIOUS THREAT"

HERE ARE THE VIEWS of Food and Drug Commissioner Dr. George P. Larrick on alleged carcinogens in foods. They are reprinted by special permission of *The Ladies Home Journal* to which, in the form of a letter to the editor,[a] they were originally submitted.

"Dear Mr. Briggs: A recent news account indicates that cancer experts attending a symposium of the International Union Against Cancer in Rome believe that a serious public-health problem is involved in the food additives used in the U. S. and in Europe. The symposium laid down the basic principle that 'no food additives should be used unless specifically permitted by legislation based on lists of substances that have been proved innocuous after stringent laboratory tests,' and gave lists of food preservatives and dyes that were found to be acceptable, dubious or definitely dangerous.

"This principle is sound and is, in fact, very similar to the views that the Food and Drug Administration has been expressing for several years. (A similar conclusion was reached by a House Select Committee in 1952.) We are not aware, however, of any evidence that any chemical additive or food dye known to be of use in this country is carcinogenic. If we had such evidence, we would, of course, take appropriate action under the Food, Drug and Cosmetic Act.

"Several chemicals mentioned in the report as carcinogenic are not, as far as we know, used in foods here. We took action against at least two of them when an attempt was made to employ them as preservatives or antioxidants in food products.

"The news report does not identify the particular food dyes classed as 'unsuitable' or 'potentially dangerous.' In this country, only coal-tar colors that are harmless are eligible for certification for food use; and only certified colors can be used in food. For the past few years, our scientists have been retesting coal-tar colors already on the eligible list; and these extensive laboratory studies have not indicated that any food color in the manner used is carcinogenic. These tests, however, have revealed that several of the colors are not

(Continued on page 8)

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(Continued from page 6)

'harmless' and can cause illness if consumed over long periods of time. Thus, three colors were delisted in February, 1956.

"A potential public-health problem does exist as the result of the rapid development of vast numbers of new chemicals in recent years. Sufficient information on the chemistry and possible toxicity of many of these new chemicals is not available; consequently this administration might not be able to prevent the use of certain such additives. Congress has under consideration a number of amendments to the Food, Drug and Cosmetic Act which would require proof of safety before additives could be used as ingredients in food products. While this problem is being given study we do not think there exists in this country a serious threat from the use of dyes or other chemical additives.

Sincerely yours,

GEORGE P. LARRICK
Commissioner of Food and Drugs"
Washington, D. C.

LATEST DEVELOPMENTS IN FIELDS OF FOOD AND NUTRITION TO BE DISCUSSED AT 1957 GORDON RESEARCH CONFERENCE

The 1957 Gordon Research Conference on Food and Nutrition will be held from 19-23 August at Colby Junior College, New London, New Hampshire.

The Gordon Research Conferences, affiliated with the American Association for the Advancement of Science, were established to stimulate research in universities, research foundations, and industrial laboratories. This purpose is achieved by an informal type of meeting consisting of scheduled lectures and free discussion groups. Sufficient time is available to stimulate informal discussions among the members of a Conference. Meetings are held in the morning and in the evening, Monday through Friday, with the exception of Friday evening. The afternoons are available for recreation, reading or participation in discussion groups as the individual desires. This type of meeting is a valuable means of disseminating information and ideas which otherwise would not be realized through the normal channels of publication and scientific meetings. In addition, scientists in related fields become acquainted and valuable associations are formed which result in collaboration and cooperative effort between different laboratories.

It is hoped that each Conference will extend the frontiers of science by fostering a free and informal exchange of ideas between persons actively interested in the subjects under discussion. The purpose of the program is not to review the known fields of nutrition and food technology, but primarily to bring experts up to date as to the latest developments, analyze the significance of these developments, and to provoke suggestions as to underlying theories and profitable methods of approach for making new progress. In order to protect individual rights and to promote discussion, it is an established rule of each Conference that all infor-

(Continued on page 10)

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But the picture isn't all black. Jim has a lot of strings to his bow—some 3500 highly purified organic chemicals. He does a nice business selling his reagents and other chemicals to food chemists for analytical and research purposes. Jim likes to feel that there are a lot of new and better food products on the market today that got their start in the lab with research done with some of his organics.

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(Continued from page 8)

mation presented is not to be used without specific authorization of the individual making the contribution, whether in formal presentation or in discussion. No publications are prepared as emanating from the Conferences.

Individuals interested in attending the Conference should request an application form from the office of the Director before 1 May 1957. Attendance at each Conference is limited to 100. Requests for attendance at the Conferences, or for any additional information, should be addressed to W. George Parks, Director, Department of Chemistry, University of Rhode Island, Kingston, Rhode Island.

Program:

Under the chairmanship of Dr. Harry Spector, Quartermaster Food and Container Institute for the Armed Forces, the 5-day program will be addressed to antibiotics in food preservation, advances in mineral nutrition, fat metabolism and atherosclerosis, advances in protein nutrition, nutrition in liver disease, food preservation by radiation, and operations research. Specialists in the foregoing areas of scientific interest will present papers. Government, industry and academic institutions of Canada, England, and the U. S. A. will be represented at the gathering.

EMIL M. MRAK DESIGNATED WINNER OF CHICAGO SECTION'S APPERT MEDAL

Not only in California but also across the nation and overseas food technologists recognize on sight a hale and hearty University of California professor who gets around. Cloistered walls have never held captive Dr. Emil M. Mrak, Appert Medalist for 1957. For more than 30 years he has been guided by the "full spectrum" point of view toward food technology; namely, seeing food technology as an integration (1) of research and applications, and (2) of people—i.e., scientists and growers and processors — all those responsible for the continuous improvement of crops, manufacturing methods, the quality of food and its proper handling. Dr. Mrak is thoroughly imbued with his credo of the full spectrum approach. Together with his able staff at the University of California, both those on the Davis campus and those at Berkeley, he has led food technology students into the disciplines of basic research but, once the techniques of research have been mastered, he has encouraged them to look squarely at the world of applications. For Dr. Mrak the guiding light in applications is also "full spectrum". The improvement of food crops, the betterment of handling and holding practices, advancements in food engineering, and enhancement of flavor, nutritional quality, etc.—these are some of the components of the spectrum.

Plenipoteniary to the food field. It has been mentioned that Dr. Mrak gets around. But it should be emphasized that, in getting around, he is never without a mission. During World War II, in Washington, he participated in the massive scientific effort to bring subsistence to the point where it could withstand the rigors of military handling and the extreme climates encountered in a war of planetary proportions. After the war, in order not to lose the momentum which he had helped to create he headed up the work of the Committee on Food Research of the Quartermaster Corps, a Committee, now superseded by another official body, the Quartermaster Advisory Board. It was the Committee on Food Research which organized food investigations at the close of the war along "team approach" lines. By means of distributing basic but realistic problems in food science among the specialists of the nation the Committee not only covered all fields of Armed Forces interest but also stabilized the whole contract research program on military subsistence. Dr. Mrak has been active in many other areas of food technology "statemanship". He has served on committees of the U. S. Public Health Service, on National Research Committees, notably on the important Food Protection Committee of NRC, on task groups of the U. S. Department of Agriculture, and, as is well known, in various executive capacities for the Institute of Food Technologists. He is presently president-elect of IFT. In all of these activities Dr. Mrak has kept in mind the purpose of these services—namely, to solve problems—and he has been anything but a mere committeeman.

Under the heading "plenipotentiary to the food field" there should also be included Dr. Mrak's many missions in behalf of food science and technology overseas. These missions have taken him to England and the continent, most recently (1956) to Switzerland. In Switzerland he lectured on food technology before various Swiss groups identified with this field. In 1956 also—in fact, on his return trip from Switzerland—he spent time in Brazil, sponsored by the Rockefeller IBEC Research Institute, analyzing the status of food technology and offering ways and means of structuring the food technology of that nation.

Contributions. Dr. Mrak, who holds three degrees from the University of California, obtained his doctorate in botany and mycology under Dr. Lee Bonar. He has published widely in this field in conjunction with Dr. H. J. Phaff, a member of his staff. His publications on dehydration and on the causes of food deterioration in storage are equally well known. He has authored or co-authored well over a hundred articles and monographs in the foregoing areas.

With his colleague Dr. George Stewart he has edited over the past several years *Advances in Food Research*, the definitive review series for the food sciences.

Comments on Dr. Mrak's contributions would not be complete without mention of the important conferences and symposia that he has helped plan, administer, and

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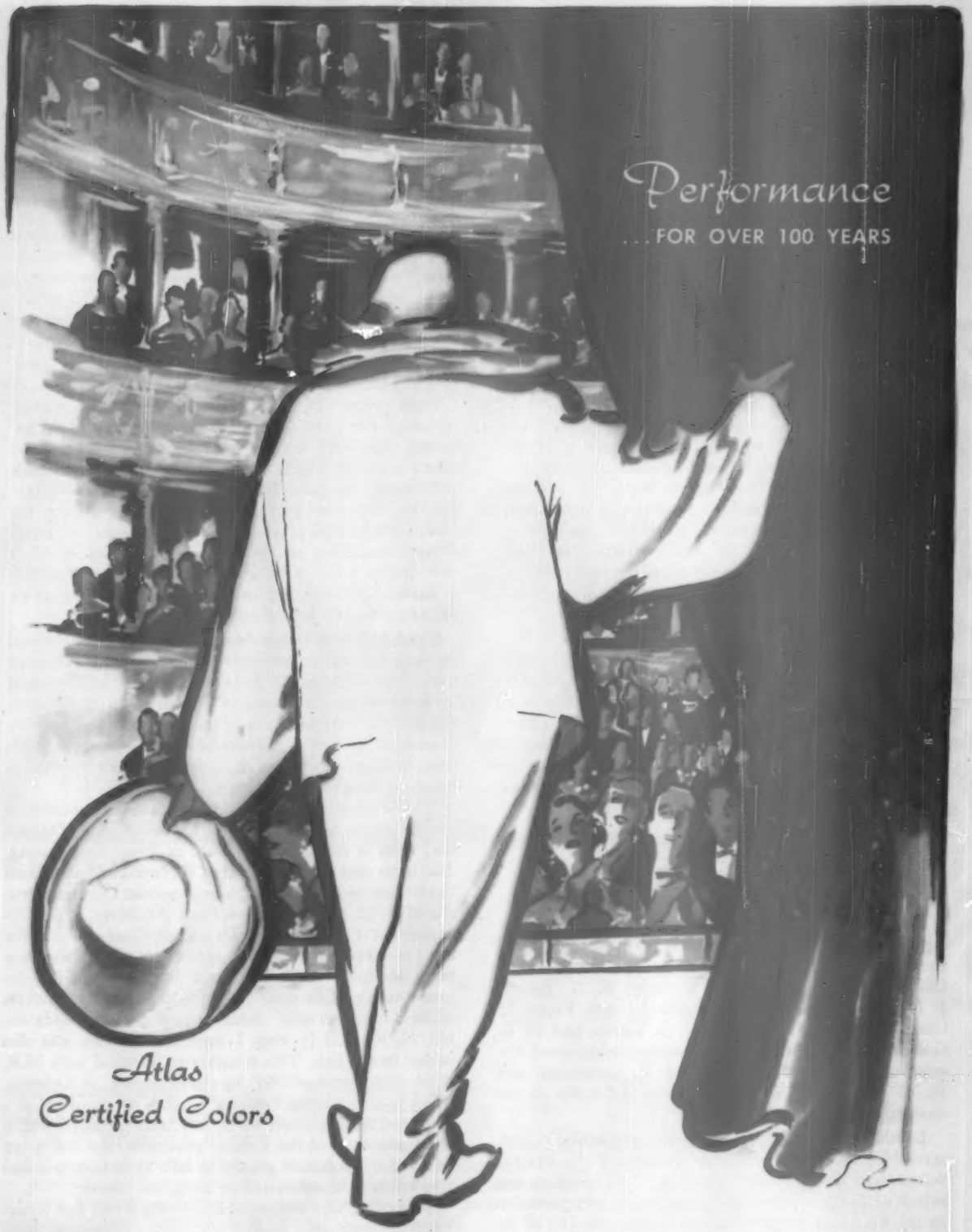

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(Continued from page 10)

chairman. The Flavor Conference in Chicago, November, 1956, is perhaps the latest example of this phase of his contributions to food research and technology.

Biographical tabs. Born in San Francisco, where his father owned a restaurant, Emil M. Mrak experienced through infancy, childhood, and early youth his share of the pleasures and vicissitudes of life. His family was living at Palo Alto at the time of the great earthquake and San Francisco fire. The quake destroyed the buildings at Stanford University and had the collateral effect of snuffing out the job that his father held with the Stanford Athletic Department, chef of the training table. The family then moved to Santa Clara and eventually to a farm near Campbell. At Campbell High School Emil was student body president, manager of the *Annual*, and as another extracurricular activity played basketball and baseball. Emil Mrak entered the University of California in 1922, worked his way through that institution, taking both his bachelor's and advanced degrees there. Dr. William V. Cruess, the distinguished professor under whose inspiration he entered upon his academic career in research, invited Dr. Mrak to join his faculty in Food Technology in the late 1920's and on the retirement of Dr. Cruess from the chairmanship, Dr. Mrak succeeded him in that office.

Dr. Mrak married Dr. Vera Dudley Greaves, a colleague on the University of California staff, in 1945. The Mraks and their two children, Bobby and Antoinette, make their home in Davis—where they have been host over the years to their fellow scientists, food industry executives, and their countless friends in other walks of life. Energy, productivity, and warm friendliness are among the many fine character traits that make up the personality of the Appert Award winner for 1957, Emil M. Mrak.

IFT COMMITTEE ON CHEMICALS IN FOODS HOLDS FIRST MEETING

This newly constituted committee held its first meeting in Washington, D. C. on December 14, 1956. Present were O. R. Alexander (representing L. E. Clifcorn), F. J. Francis, B. L. Oser, F. N. Peters, J. L. Powers, H. C. Spencer (Secy.) and Frank L. Gunderson (Chr.). Messers. R. D. Gerwe and G. F. Garnatz were absent. Comprehensive minutes of the meeting were submitted by Frank L. Gunderson and H. C. Spencer. A summary of the highlights of the meeting follows.

Labeling preservatives. Regarding labelling of preservatives in raw agricultural products, F. J. Francis volunteered the following statement: "The question was raised as to the significance of the recent interpretation by the Food and Drug officials of Section 403 (k) of the Food and Drug Act, to include preservatives in raw agricultural produce under the labelling requirements. Produce treated with chemicals applied either pre- or post-harvest in order to retard deterioration in the product must be appropriately labelled. This requirement affects only a relatively small number of agricultural chemicals at present because it was learned from a letter sent to the citrus growers by the FDA officials that 'We have never regarded insecticides, rodenticides or fungicides intended for the control of diseases of the growing plant as chemical preservatives and we see no reason to change our traditional views on the compounds'.

"There may be some difficulty in interpretation in the fringe areas where pre-harvest sprays may also have post-harvest preservative effects but this will probably require a special ruling. The question of health hazards is not involved here since this would be subject to the Miller Bill not the labelling requirements. However, the psychological impact on the consumer of chemicals in raw produce is important in terms of consumer confidence in all foods."

Food colors. D. A. Gerwe sent word that representatives of the color manufacturers have formed an informal committee for the purpose of discussing food colors with the FDA. They have agreed to assemble and supply use data, showing the total amounts of certifiable colors used in foods in the U. S. per year, the kinds of foods in which they are used, and the levels of use. According to Mr. Gerwe, it seems to be fairly well indicated that steps are being taken in the direction of *having tolerances set on the amounts of colors which might be used in food products.*

Food additives legislation. The committee discussed the pros and cons of providing for an Ad Hoc Advisory Committee of Scientific Experts somewhat as advocated by Dr. Oser in his testimony (by letter) to the Health and Science Subcommittee of the Interstate and Foreign Commerce Committee, House of Representatives, 84th Congress; however, the committee did not express a group opinion on that point.

Washington Attorney, John A. Gosnell, published a review article on the legislative situation as of December, 1956 in the December issue of *Food Engineering*. The issue also carries a related Editorial. (Subsequent to the date of this meeting, Congressman O'Hara introduced H. R. 366, Jan. 3, on Food Additives, a Bill "to amend the Federal Food, Drug, and Cosmetic Act for the protection of the public health, by prohibiting new food additives which have not been adequately pretested to establish their safe use under the conditions of their intended use." Another food chemical additives bill, H. R. 4432 by Rep. Leonor K. Sullivan, was also added to the list. This measure is identical with H.R. 4014 introduced earlier by Rep. James J. Delaney. FDA is also putting finishing touches on the draft of a proposed additives bill which has been prepared within the framework of the Folsom principles, but spells out some of the points in greater detail. It is expected that this bill will be submitted in Congress shortly.

According to a statement by Deputy Food and Drugs Commissioner John L. Harvey, FDA's doors are "wide open" to industry representatives who want to discuss possible compromises of differences on food chemical additives legislation. FDA is now in a position to "talk turkey" on specific provisions of bills already pending as well as its own version.

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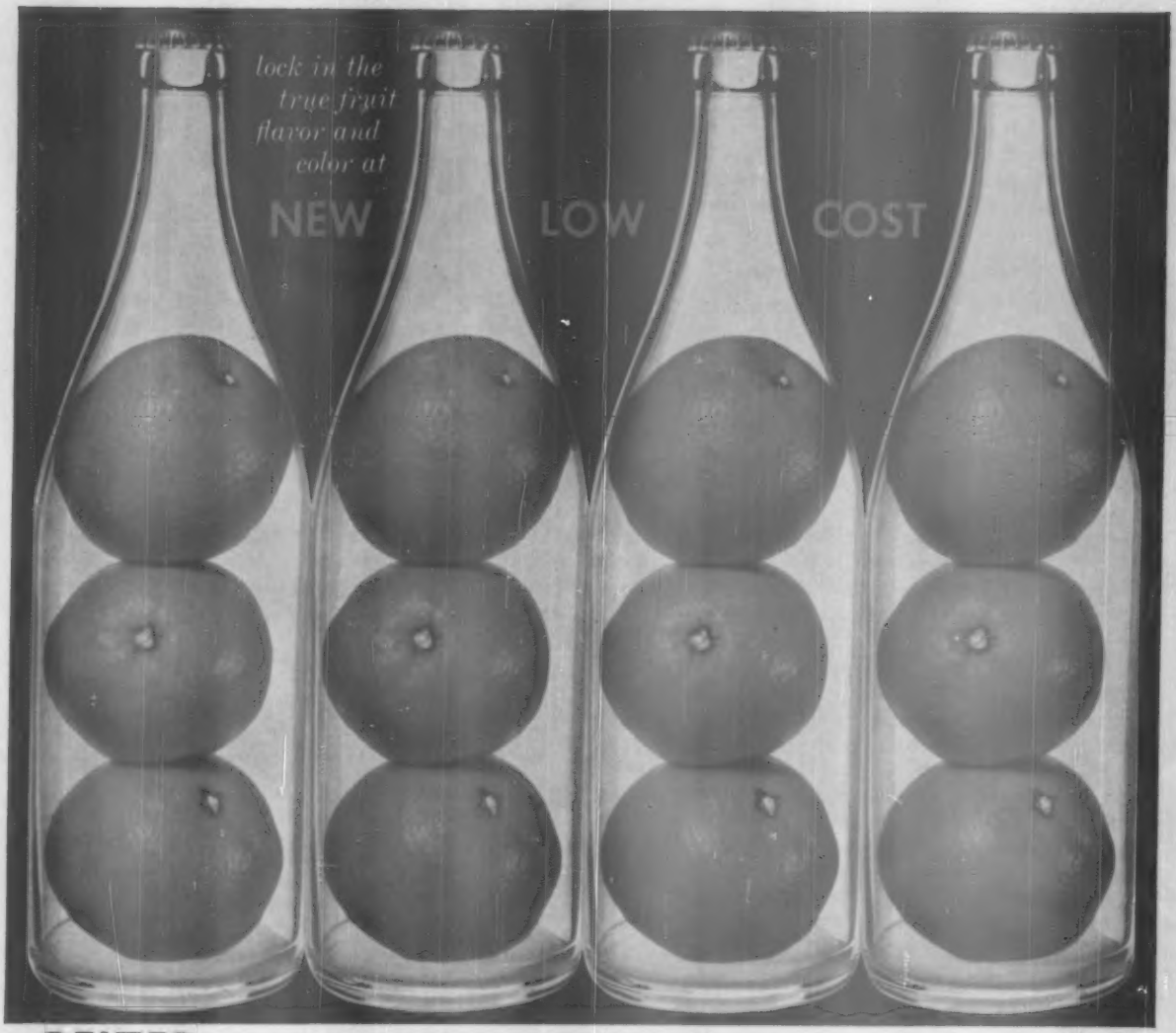

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(Continued from page 12)

Mr. Harvey told *Food Field Reporter* that "FDA has no plans to call a general meeting of industry to discuss the legislation, nor does FDA plan to invite particular representatives to come in for such discussions." However, he emphasized that any who care to come will be welcome.

Coal Tar Colors Again in Spotlight

On Jan. 24, the FDA started proceedings which could result in a ban on four coal tar colors, FD&C Yellow Nos. 1, 2, 3, and 4. Only small amounts of No. 1 have been certified; no lots of No. 2 have been certified but Nos. 3 and 4 are extensively used in coloring butter, oleomargarine, and other food products. Although there have been no reports of any injurious effects on humans from any of the colors, animal experiments indicate that excessive amounts could cause injury. And since the law requires that an approved coal-tar color must be "harmless" regardless of the amount used, says FDA Com. George P. Larrick, the agency has no choice but to initiate proceedings to remove them from the list of colors certified for food use.

FDA also published two proposed revisions of the definition of a coal-tar color as it appears in the color certification regulations. The proposal of Commissioner Larrick would exempt from certification carbon black, caramel, and a number of colors derived from vegetable sources. A counter proposal offered by Hoffman-La Roche would exempt the same vegetable colors and "identical compounds produced by chemical synthesis, without change of chemical structure." This proposal would exempt synthetic carotene from certification; under the FDA proposal it would be certified.

Food Protection Committee Reports on Safety of Surfactants in Foods

The Food Protection Committee of the NAS-NRC Food and Nutrition Board was requested by its Liaison Panel to examine the proposition that all surface-active agents (surfactants) are undesirable food additives. This proposition implies that surfactants are undesirable as a consequence of their having in common the property of surface activity.

The literature concerning the biological effects of surfactants is extensive. The F.P.C. reviewed recent reports on the subject in attempting to answer the question of whether or not a surfactant present in low concentration in foods would produce adverse physiologic effects solely because it lowers interfacial tension. Although only a few of these contributed directly to answering the question, consideration of those dealing with a variety of biological effects helps form a basis for judging the relation of surface activity to safety.

The report entitled "The Relation of Surface Activity to the Safety of Surfactants in Foods" was prepared by the Toxicology Subcommittee of the Food Protection Committee.

The Committee, in presenting its findings, deals primarily with the property and not with compounds. Discussion of safety of specific surfactants for use in foods is avoided, and quantitative data are used infrequently and only to illustrate general differences in toxicity among surfactants or classes of surfactants.

The Committee concludes that there are no toxic effects common to all surfactants, that surface activity *per se* is not a measure of toxicity and that the safety of each surfactant for use in food must be determined separately. The bibliography comprises 76 references on this subject. (Publication 463 of the National Academy of Sciences-National Research Council, Washington, D. C., 1956.)

Appointments to Food Standards Committee Announced

Appointment to the Food Standards Committee of the Food and Drug Administration were announced recently by Commissioner Geo. P. Larrick. The committee, an advisory group which makes recommendations to the Commissioner in regard to food standards, consists of Frank A. Vorhes, Chairman; Joseph Callaway, Secretary; and Malcolm R. Stephens, Gilman K. Crowell, Joe F. Lakey, T. E. Sullivan and Orlen J. Wiemann.

The committee plans a meeting early in 1957 to discuss problems and situations now requiring attention. Consumers, officials, and members of the food industries who have suggestions for consideration by the committee are invited to send them to Joseph Callaway, Food Standards Branch, Food and Drug Administration, Washington 25, D. C.

Proceedings of the Perkin Centennial to Be Published

All of the papers presented during the Perkin Centennial will be assembled and printed in one volume entitled *Proceedings of the Perkin Centennial*. A copy of this volume will be sent to every registrant. While many of the papers will appear in the official publications of some of the participating societies, this book of proceedings will be the only source for all of them. Undoubtedly, they will be very valuable for reference purposes in the years which lie ahead. Additional copies of this book can be obtained at a cost of $10.00 from Richard R. Frey, Assistant Secretary, A. A. T. C. C., Lowell Technological Institute, Lowell, Mass.

Handbook on Chemical Additives Available

Technological benefits of intentional additives, and a listing of intentional additives used in processed foods as preservatives, surfactants, etc. are thoroughly covered in the handbook *The Use of Chemical Additives in Food Processing*. This authoritative reference, a 91-page publication, No. 398, February 1956, of the Food Protection Committee is highly acclaimed by food technologists. It is available at $2.00 per copy through the Publications Office, National Academy of Sciences-National Research Council, 2101 Constitution Avenue, Washington 25, D. C.

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Role of the Independent Consulting Laboratory in the Service of the Food Industries[a]

Bernard L. Oser, Director
Food Research Laboratories Inc.
Long Island City, New York

EVERY TIME I RETURN from a trip overseas I am re-impressed by a uniquely American characteristic. Each of us in this country is genuinely curious about the other fellow's work. We want to know what he does, whom he works for, what purpose his job and his company serve. That's a healthy curiosity, one which helps us satisfy many of our psychic and business needs. But it's somewhat different abroad. When two business men meet one may query the other with a semi-formal "What line are you in?" The response, as often as not, is monosyllabic—"Tea".

Bernard L. Oser

I am glad we on this continent all share the sort of curiosity in depth that we do. "Tea" doesn't satisfy us. We want and need to know more because we progress by knowing more of how other businesses or other professions operate. The insight and perspective that we gain thereby are of real value to all of us, particularly to those in service organizations such as our Laboratories. It helps us to channel our efforts more efficiently and to provide services more useful to clients.

All occupations and enterprises, of course, have novel aspects. But few, it seems to me, have quite as many unique and interesting characteristics as does the independent consulting laboratory. It holds a special position of responsibility for the industries it serves—a responsibility and function distinct from those of academic, government and industrial laboratories.

"Independent" is a key word in describing a consulting laboratory. Implicit in the term is not only a complete absence of financial interest in the products or operations of any companies in the fields it may serve, but also a nonassociation with collateral activities—such as academic work or law enforcement. It must be so, otherwise its scientific objectives would be confused, the time and interests of its personnel divided and diluted. It might well be emphasized, too, that complete dedication to the problems and purposes of industrial clients is not in the least incompatible with impartiality and scientific objectivity.

[a] Presented before the New England Section of IFT, Amherst, Massachusetts, October 6, 1956.

A multifaceted industry

It is not always recognized that the food industry is one of the most multifaceted of all industries, yet it certainly is. At the agricultural level, it involves the control of soils, the growing, harvesting and storing of grains, grasses, fruits and vegetable crops, the raising of poultry and livestock, the production of milk and eggs. Under this general heading of basic food production might be placed, too, the harvesting of the myriad varieties of fish and shellfish from rivers, lakes, and seas. And all this has to be transported to the points of processing and distribution, involving refrigeration, fumigation or other forms of preservation against spoilage by enzymes, microbes, or pests—all important facets of the food industry.

In the plant or factory, the processes of screening, washing, peeling, milling, refining, dehydration, sterilization, pasteurization, homogenization, compounding, fermentation, cooking, baking, canning, packaging, etc., introduce new complexities. The maintenance of high standards of quality in terms of retention of both optimal nutritional value and the esthetic characteristics of flavor, texture, color and appearance, demands vigilant control at all stages of food production and processing. The packaging of foods, whether in the natural, heat processed, refrigerated or frozen state, poses many challenging problems in these days when eye-appeal, convenience, and long shelf-life are demanded by the consumer.

With all those ramifications to deal with, the consultant's life is one of fascinating variety. Apart from coming into contact with many specialists in the food industry itself, he also discusses technical and business matters with importers, advertising agencies, brokers, medical and legal practitioners, government officials and many others in related professions.

All of this demands a versatility of skills and a background of experience as a basis for providing what we might categorize as a spectrum of services. Indeed, it requires that any competent consulting food laboratory maintain a vast reservoir of knowledge drawn from a voluminous and growing technological literature and integrated with the particular abilities of its own staff. The frontiers of scientific research must be under constant surveillance for developments which may, either favorably or adversely, affect the interests of clients. Conversance with basic and special food laws is a prime requisite; so is a familiarity with proposals to amend the laws or regulations as well as with current activities of enforcement agencies.

(Continued on page 18)

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(Continued from page 16)

These duties are a sine qua non for the proper fulfillment of any independent consulting laboratory's responsibility. However, as I have intimated, they also provide a zestful flavor of variety, interest, and excitement to those who are so immersed in the profession.

Food processing used to be simple, straightforward

There has been in recent years a marked increase in the complexity of both the food industry and the laboratories which serve it. A generation or so ago food processing and packaging was simple and straightforward. It was in the main just a matter of extending a few kitchen principles. Protein quality, browning reaction, pesticidal residue, and triangle test were terms and concepts that did not burden us. For instance, when our Laboratories were founded some thirty-five years ago the scientific equipment which was required was of a modest and elementary nature. Indeed, it was considered quite advanced to possess a Dubosq colorimeter, a pH meter, or a few white rats. It is vastly different today. Now, any up-to-date laboratory must be equipped with a whole array of intricate apparatus and instruments. But fortunately the new (and costly) equipment has contributed much to progress. Modern techniques of evaluation offer much greater scope: photometry over all ranges of the spectrum, radioisotope analysis, chromatography, microbiology, and bioautography on columns, on paper, and even in the vapor phase, to name but a few.

A phenomenal advancement in analytical methodology

No aspect of food science has witnessed more phenomenal advancement in the past 25 years than has analytical methodology, without which the discovery of new vitamins, the establishment of nutritional values and requirements on a quantitative basis, and quality control as we now conceive of it, would have been impossible. We in our Laboratories have made and published contributions to the assay of vitamin A, thiamine, niacin, pyridoxine, ascorbic acid, and other vitamins; we introduced and developed the human bioassay for the physiological availability of vitamins; and more recently have been occupied wtih the development of highly sensitive methods to determine residues of certain pesticides and antibiotics in foods. Especially interesting to our scientists are the projects which require analytical ingenuity or inventiveness as, for example, the combination of paper chromatography with microbiological agar plate assay to which we gave the name "bioautography". Microbiological data for the amino acid composition of proteins were shown in our Laboratories to have more meaning when integrated into an Essential Amino Acid Index since they could be correlated closely with the biological value as determined by nitrogen balance studies in rats.

The development of characteristic physical and chemical identity tests for individual brands of foods, drugs, and especially cosmetics, sufficiently specific to stand up in court actions against imitators, has frequently posed challenging problems which our analysts have solved.

In the field of food development, nutrition meets with food technology in the evolution of special dietary foods. Tremendous progress in pediatric nutrition has taken place during the past few decades—progress which now shows promise of being duplicated in geriatric feeding. Many food companies are becoming interested in the possibilities of this market for the fulfillment of which, however, much fundamental work in nutrition needs to be done. The need for limiting calories, sodium and cholesterogenic fats in the diets of those of advancing age are a few of the many phases currently being studied.

Despite all the precision equipment which electronics and ingenuity have made available, experimental animals are stll a vital part of the armamentarium of the research laboratory specializing in nutritional and toxicological investigations. Whereas the analytical chemist car. tell us exactly how much of a given substance is present in food, only the animal organism can tell us whether it is beneficial or harmul. It is upon rats and dogs, and to a lesser extent mice, guinea pigs, chicks and rabbits that we rely to establish the safety of food additives, both incidental and functional. Present day requirements are that toxicological investigations be conducted on at least two species (one rodent) for acute, sub-acute and chronic effects. Observations are made of growth, appetite, food utilization, effects on behavior and physiological responses such as reproduction, and lactation, hematological and urological changes, mortality rates, and gross and microscopic pathology. Wherever applicable, biochemical studies are also conducted to determine the metabolic fate, paths and extent of elimination of the compounds in question. Intensive investigations of a special type are required when dealing with a suspected or potential carcinogen.

Such testing—if it is to be meaningful—demands years of experience in the maintenance and breeding of numerous species of animals, particularly if the feeding periods are of long duration. We have found it desirable to maintain our own rat breeding colony from almost the inception of our Laboratories. In this period, more than 160 successive generations have been reared.

Not less important than the proper planning and conduct of animal studies is their interpretation and reporting either to clients, before scientific meetings, or as testimony before appropriate administrative or judicial agencies. This latter necessitates an intimate knowledge of technical and procedural requirements as well as preparedness to substantiate the evidence with support adequate to withstand critical appraisal or attack.

The consultant as expert witness

Not infrequently, of course, consultants are called upon to testify at public hearings held under the auspices of the Food and Drug Administration, the Federal Trade Commission or other governmental bodies. And they often are required to provide expert testimony or guidance in litigations.

In court cases, for example, the chinks in technical armor are often not recognized by the claimant or his legal counsel. It is the responsibility of the technical

(Continued on page 20)

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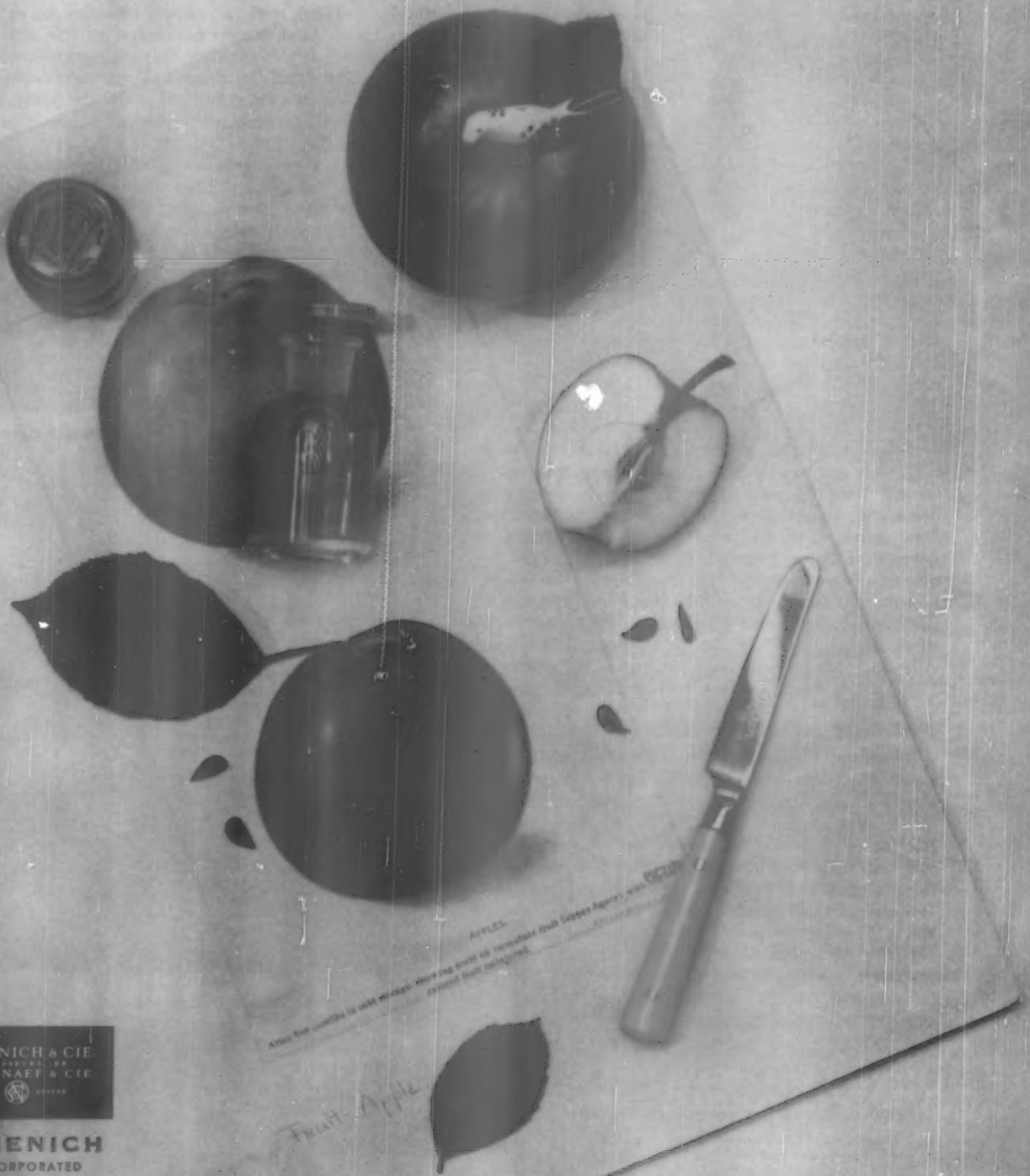

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(Continued from page 18)

expert to detect these weaknesses and to advise accordingly. As a result of such scientific counsel, many an intended lawsuit for food poisoning has been abandoned or settled without a costly trial. Correspondingly, and still within the area of court or private controversy, laboratories like ours play an important role in legal disputes such as those involving transactions in which goods fail to meet specifications; claims against public carriers or warehouses for deteriorations of produce in transit or in storage; cases involving substitution for brand-named goods; and, naturally, violations of federal or regional food or drug laws.

Lawsuits pose a variety of interesting problems to the independent laboratory whose staff must be both prepared and qualified to appear as expert witnesses. What may seem to be a clear, understandable and factually acceptable statement to the scientific mind can, by a deft legal cross-examiner, be made so confusing as to be completely misunderstood by a jury of laymen. However careful and reliable the work in the laboratory has been, improper or inept presentation in court can jeopardize, if not lose, a meritorious case.

To answer court questions adequately, a chemist's knowledge must extend beyond the data gleaned from laboratory work alone. Indeed, he has to become somewhat of a detective so that he may learn all that he can of all the circumstances which surround the controversy. For how else could he arrive at an objective opinion on such questions as these?

Did the imported Easter cakes turn moldy because they were made under unsanitary conditions or because they were improperly stored in a commercial warehouse? Were the pork loins the woman bought at the defendant's store that particular day responsible for her family's siege of trichinosis? Did the vitamin A potency of the concentrate deteriorate before arrival overseas because of the "inert" carrier? Are vitamin preparations foods, or are they drugs which should be sold only by registered pharmacists? Was the frozen meat tainted before or during shipment from South America? Many such issues wind up in the courts but fortunately a few are settled on their merits.

Burdensome but never boresome

These are but some of the variegated activities of independent consulting laboratories. Ours is not a simple single phase business; ours is not just being "in Tea". But demanding as the laboratory profession may be on occasion, burdensome though the problems and responsibilities we must shoulder, few are those of us who do not relish a sense of excitement and adventure and the thrill of accomplishment. And, importantly, the feeling that we are contributing in some degree to the progress and development of the nation's vital food industry.

DIXIE . . .

The second winter meeting of the Dixie Section was held on 8 February 1957 with 51 members and guests attending the dinner and evening meeting at the Cherokee Room, Cherokee Hotel, Atlanta, Georgia. This meeting was held earlier in the year than usual to enable us to be addressed by Dr. John M. Sharf, Glass and Closure Division, Armstrong Cork Company Research and Development Center, Lancaster, Penn. Dr. Sharf is a specialist in the processing and packaging of beverages, foods, drugs and related products. He was one of the scientists who observed the various violent effects of nuclear explosions on commercially packaged foods and beverages during the 1955 Continental A-Bomb tests. Dr. Sharf reviewed the results of extensive laboratory examination of the exposed products and showed excellent on-the-scene color photographs. The details of these findings were well presented by the Maryland Section in the December 1956 issue of FOOD TECHNOLOGY and need not be repeated here.

This was a very interesting and informative program. We urge other sections to secure Dr. Sharf for their programs if possible. Dr. Sharf's extensive academic training and varied experience was evidenced by the manner in which his presentation appealed to the audience representing the food and beverage industry, consulting firms, research organizations, and educational institutions.

GREAT LAKES . . .

Dr. James C. MacDonald of McMaster University, Hamilton, Ontario, was presented with the Gerber Post-Doctoral Fellowship Award, totaling $6,000, at the Jan. 25 meeting of the Great Lakes Section, Institute of Food Technologists, held in the Secor Hotel, Toledo.

Presentation of a plaque, symbolic of the award, was made by R. B. Wakefield, Technical Director of Gerber Products Company, Fremont, Mich., who announced that the award was made on the basis of Dr. MacDonald's studies into "The Action of the Vitamin

(Continued on page 22)

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(Continued from page 20)

Biotin." Judging was done by the Institute of Food Technologists.

The award will permit Dr. MacDonald to continue his studies in this field for another year. He received his B.S. degree in Chemistry in 1949 at the University of Alberta, Edmonton, Canada, and his Master's and Ph.D. degrees in Physiological Chemistry in 1951 and 1953 respectively at the University of Wisconsin, Madison, Wis.

Other highlight of the program was a talk given by Dr. George F. Garnatz, Director of the Kroger Food Foundation, Cincinnati, and president of the Institute of Food Technologists.

Besides outlining plans for the 1957 IFT meeting at Pittsburgh, Dr. Garnatz discussed "Consumer Testing" and described the development of the methods used by the Kroger company in gauging consumer acceptance. He said that decisions formerly based on opinions of key men in the company had given way to those based on findings of large consumer panels.

Others on the program and their subjects were Dr. Georg Borgstrom, Professor of Fruit and Vegetable Products, Horticulture Department, Michigan State University, "Fat Stability in Food Products"; Dr. G. T. Peterson, Assistant to the Packaging Engineering Manager, Continental Can Company, "Containers"; Dr. V. R. Cahill, Meat Laboratory, Ohio State University, "Meat Research"; and Carl Mayo, Chief Chemist, Gerber Products Co., "Fly Bio-Assay Evaluation of Insecticide Residues."

Professor W. F. Robertson, Department of Horticulture, Michigan State University, Chairman of the Great Lakes Section, and Max Dietz, Assistant to the Technical Director, Gerber's, Program Chairman, presided at the sessions.

Owens-Illinois Glass Company which arranged a tour through its Libbey Glass plant for the 60 visitors was host at lunch and presented souvenirs.

NEW YORK . . .

"Innovation as the Route to Business Success" was the subject of a talk by William R. Hesse, Senior Vice-President of Benton and Bowles advertising agency, at the New York IFT meeting on Wednesday, February 20.

To illustrate the importance of innovation, Mr. Hesse quoted figures showing how research-minded companies tend to grow much faster than companies which are not research-minded. This is as true for food as for non-food companies in the U. S. economy. But he warned that change for change's sake will not produce results. "Every new product must contain some consumer benefits," he cautioned, emphasizing that improved quality and greater convenience are the two most important consumer benefits. Another is the creation of new uses and new recipes for established products. If the food technologist can provide these, the sales and advertising functions have much sounder and more effective grounds for creating consumer appeal and demand.

Mr. Hesse's was the fourth talk in the New York section's 1956-57 series on the theme New Product Development. It has featured speakers from outside the food industry to show the food technologists how their contributions can be made more effective and successful. The meetings have attracted wide interest and enthusiastic response from members and guests.

Each of the speakers in the series has pointed out that the food technologist should be considered as part of the team creating new products. In turn, the food technologist should take into consideration all the other functions — marketing, engineering, production and finance—of new product development.

In concluding his talk, Mr. Hesse pointed out that "we are in an ascendancy of new ideas," but cautioned that innovation must add real value if the development is to be successful in the long run.

OMAHA . . .

The first meeting of the Ak-Sar-Ben Chapter of the Institute of Food Technologists for 1957 was held at the Omaha Airport Hayden House Wednesday, January 30. After dinner, new officers, Chairman, Dr. R. E. Feeney, University of Nebraska; Vice Chairman, Mr. John Meader, Continental Can Company; Secretary-Treasurer, Mr. Walter E. Wood, Ocoma Foods Company; National Councilor, Mr. W. E. Phalen, Cudahy Packing Company, were installed.

Twenty-three members from eleven industrial, educational, and governmental sources were in attendance. Four new local members were accepted.

Our National IFT president, George Garnatz, spoke on the consumer research activities of the Kroger Foundation.

PITTSBURGH . . .

The 32nd official meeting of the Pittsburgh Section of the Institute of Food Technologists was held on Tuesday evening, January 8, 1957, at the Royal York Apts. Dining Room. Following a pleasant social hour and an excellent dinner, the meeting was called to order by the chairman, Dr. C. R. Stumbo. Dr. Hutchings moved that, due to the urgency of incorporating the Pittsburgh Section, the executive committee should be empowered to alter the by-laws as dictated by the return ballots, and to proceed with the draft of a revised set of by-laws for presentation to the section members. It was unanimously approved by all members present.

Dr. Stumbo requested Dr. B. R. Suri to discuss the matter of bringing food technology news to the public by way of home television. Dr. Suri announced that he

(Continued on page 24)

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(Continued from page 22)

has talked with the program manager of television station WQED and that he is willing to allow us television time. He further stated that it could be arranged to televise some of the programs of the 1957 Convention. Mrs. Margaret New was appointed to head a committee to arrange time, date and program for TV.

Dr. Buck introduced Mr. H. M. Rivers, Director of Engineering Services of Hagan Chemicals & Controls, Inc. Mr. Rivers presented an illustrated talk concerning the treatment of industrial waters. He discussed scale formation in boilers and pipe lines, giving a brief history of early measures taken to prevent scale formation. He stressed the importance of knowing the water source and making complete analytical tests of the water to help locate the trouble source. Mr. Rivers discussed the mechanisms of steam generation and neutralizers commonly used for steam condensate. He also gave the examples as to how tomato catsup was sucked into the boiler from a leaky steam jacketed kettle. Of all the problems involved, he stated that the toughest to solve are those associated with "carryover" products in the boiler water. He also discussed the various chemicals used for the treatment of waters.

CHICAGO . . . .

At the meeting of the Section on February 11, 1957, speaker of the evening was Frank N. Rawlings, Director of Research for the Amalgamated Sugar Company, Ogden, Utah. Dr. Rawlings presented an informative talk on the development and use of a portable and economical dissolving device for blending granulated sugar with water, according to exacting specifications. By this means sugar can be liquefied at rail side and pumped to storage tanks. The advantages of this development are that disposable packages are eliminated, maximum sanitation is achieved and labor costs are reduced as compared to that of bulk sugar handling and warehousing. The cash savings of the liquid unloading system as compared to handling bag sugar amounts to from 5 to 40 cents cwt.

MARYLAND . . .

The Section met on Friday, February 8th, at the Stafford Hotel in Baltimore with 42 members and guests in attendance. After a short business meeting the Section was addressed by H. Clifford Scott, Eastern Representative, Packaging Research, Owens-Illinois Glass Company. His topic was "Packaging Food in Glass Containers". A film was shown demonstrating new points of interest in glass packaging, with particular reference to high speed equipment. Mr. Scott then spoke of the new advances in the glass packaging field. He stated that in the last four years more advances were made than in the previous ten years. The emphasis today is on higher speeds of packaging per man hour, due to increased costs. All phases of production and packaging must be geared to the higher speed of operation. He also discussed the relationship of the food technologist to the newer problems raised by high speed packaging.

PHILADELPHIA . . . .

February. The monthly dinner meeting of this Section was at Drexel Institute of Technology on February 5 with 93 members attending.

After the usual splendid dinner one of the Section's original chartered members, Mr. W. Earl Grahm, presented an illustrated talk on the topic "Food Aerosols". Mr. Grahm who has had considerable experience with the manufacturing of this type of can is division manager of research of the Crown Cork & Seal Co.

The speaker confined his remarks principally to the history, growth, formulation and packing procedures of whipped cream and toppings. He discussed both the advantages and disadvantages of food aerosols. As an example of a disadvantage tomato catsup dispensed as an aerosol lost most of its color and no longer appeared like the familiar appetizing red color. One of the principal advantages of aerosol packaging is the convenience of dispensing. The problems of stability, public health regulations, and economics were also outlined.

Although there appear to be many foods which may be packaged as an aerosol Mr. Grahm stressed the need of considerable reformulations of existing food products. Perhaps a new type of whipped salad dressing is one of these possibilities.

As an added attraction in this meeting a color-sound film entitled "Bright Steel" was shown. This is a "four bell" production describing the story of tin plate for the manufacturing of our modern can. The film was provided by Bethlehem Steel Co. and is recommended to the other sections.

March. At the March 5 meeting, a dual presentation on "Packaging Functional and Surface Design" was offered to the Section at the Drexel Institute.

Mr. Bauer, an outstanding consultant package engineer, who has devoted his entire adult life to food packaging presented the "Functional Design and Mechanical Operation" of packaging. Mr. Cawley, a distinguished professional industrial designer from Mel Richman Inc., one of the largest advertising art studios in the country, discussed the "Surface Design" of food packages.

The speakers assumed that they had received an inquiry from a food manufacturer who desired to market a new food product. The progressive steps taken to package this product with all the complex problems were discussed.

SOUTHERN CALIFORNIA . . . .

The Magic Barrel brought 90 people to the Rodger Young Auditorium in Los Angeles on February 20th in the monthly meeting of SCIFTS. Mr. Harry Gaynor of the Standard Oil Company of California had

(Continued on page 26)

A Restatement of Policy by

KNICKERBOCKER MILLS CO.

In 1957, Knickerbocker Mills marks its 115th Anniversary, a most appropriate time to reflect and to restate the principles that have guided the company through the recent trying years.

Those familiar with spices know only too well the crises that have affected the industry; crises due to the international situation, making the importation of natural spices from areas behind the iron curtain almost impossible; crises due to the natural elements of hurricanes and storms such as experienced in the British West Indies during 1955; crises consisting of economic pitfalls in rising costs, affecting everyone from the manufacturer right down to the user.

Knickerbocker has weathered these crises for 115 years! Knickerbocker has taken them all in stride, and furthermore, has responded to the challenge of these conditions with courage and positive thought. In the face of these problems, some spice houses have attempted to exploit these difficult conditions by over-emphasizing their low prices, their discounts, their financial deals. We at Knickerbocker, have not lowered our prices, for if we did, we would sacrifice the quality of our spices.

We have never tried to be the lowest in price . . . but rather the highest in quality!

Knickerbocker quality applies not only to the very finest spices, unique in aroma and texture, selective in origin and blending . . . but to the quality of service and the dedication to greater effort as well. Knickerbocker assures you of the quality and uniformity of shipments. Knickerbocker guarantees you the best, in the amount you request, at the time you need it.

Yes, that *small . . . but so significant* little spice that gives your product its taste, its flavor, and above all . . . its sales appeal, is something whose importance you cannot overlook.

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(Continued from page 24)

charge of this Magic Barrel which served as the title of his talk. Accompanying his talk with eye-catching demonstrations, Mr. Gaynor discussed petro-chemicals that are used in the food field. These ranged from soil sterilants and seed protectants applied before crops are planted, and therefore from the beginning of food, to the plastic films used to package the final products as purchased by the homemaker.

PERSONNEL

DR. LLOYD A. HALL has recently been appointed to a three-year term on the Advisory Board of Chemical and Engineering News of the American Chemical Society."

DR. Z. I. KERTESZ, Professor of Chemistry, Department of Food Science and Technology, New York State Agricultural Experiment Station, Cornell University, Geneva, was granted a sabbatical leave to allow him to serve as Food Technologist on a forthcoming military nutrition survey in Turkey. The three-months' survey will start in April and will be under the joint auspices of the Turkish Government and the U. S. Interdepartmental Committee on Nutrition for National Defense.

Professor Reese H. Vaughn of the Department of Food Technology, University of California, Davis, left the United States February 19 for a six months' sabbatical leave in Brazil. The leave is planned to acquire new knowledge in two food fermentations: coffee and cacao. Research and investigations into these two fermentations will be carried out in collaboration with Dr. Jayme E. Almeida, Instituto Zimotecnico, Piracicaba and Dr. Ciro Teixeira, Instituto Agronomico, Campinas. A third fermentation involving concentration of tomato pulp will also be investigated.

Reese H. Vaughn

In addition, Dr. Vaughn will deliver a series of postgraduate lectures on food technology and help organize a teaching curriculum and a research program in food microbiology in a new department of food technology at the Instituto Zimotecnico at Piracicaba.

During his stay in Brazil Dr. Vaughn will investigate as much of the food industry in that country as possible. It is also planned to visit the olive industry in Argentina as well as in Brazil.

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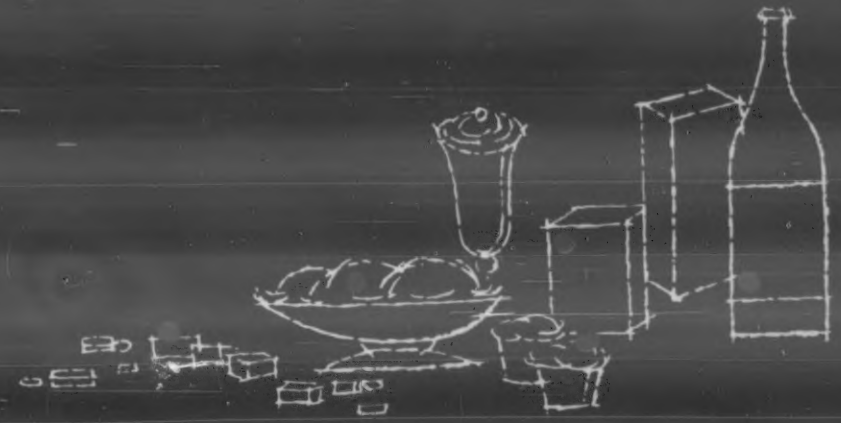
FUTURE MEETINGS FOR FOOD TECHNOLOGISTS

1957

April 23-25	Annual Meeting of the Research and Development Associates, Food and Container Institute, Inc., Jefferson Hotel, Richmond, Virginia
April 25-26	Eleventh Annual Production Conference, Pennsylvania Manufacturing Confectioners Association, Franklin and Marshall College, Lancaster, Pennsylvania
April 30	Forty-eighth Annual Meeting of the American Oil Chemists' Society, New Orleans, Roosevelt Hotel
April 30-May 2	A. O. C. S. Spring Meeting, Roosevelt Hotel, New Orleans
May 11-14	National Independent Meat Packers Association, Palmer House, Chicago
May 12-16	**Seventeenth Annual Meeting of the Institute of Food Technologists, Penn-Sheraton Hotel, Pittsburgh, Pennsylvania**
May 14-16	Second Annual Industrial Nuclear Technology Conference, Museum of Science and Industry, Chicago
June 8-12	Technical Personnel Recruiting Exposition to be held in conjunction with the National Technical Career Conference. Information can be obtained from Marcus W. Hinson, Director, Technical Career Conference, 19 South La Salle St., Chicago 3
June 9-13	Seventy-fifth Annual Convention of the National Confectioners Association, Conrad Hilton Hotel, Chicago
August 19-23	Gordon Research Conference on Food and Nutrition, Colby College, New London, New Hampshire
November 18-December 9	Ninth Pacific Science Congress of the Pacific Science Association, Chulalongkorn University, Bangkok, Thailand

An open invitation is extended to readers of FOOD TECHNOLOGY to send in to the Editorial Office, 11606 South Bell Avenue, Chicago 43, Illinois notices of annual or national meetings of interest to food technologists.



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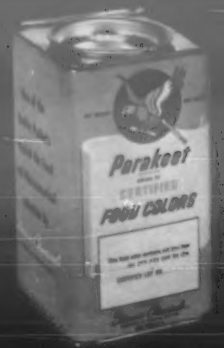

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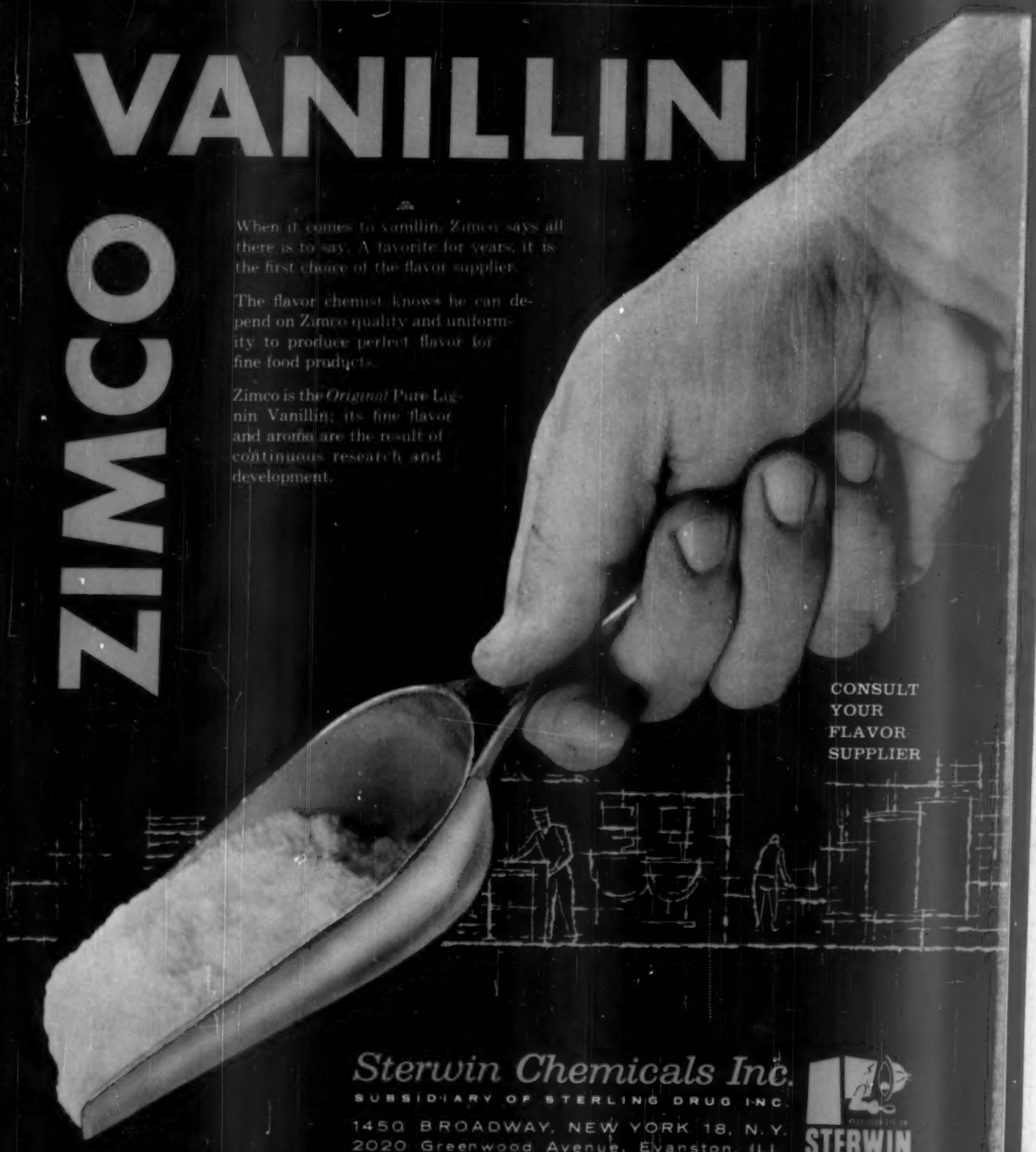

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Effect of Controlling Environmental Conditions During Aging on the Quality of Beef[a, b, c]

R. B. Sleeth, R. L. Henrickson,[d] and D. E. Brady
Food Processing Laboratories, Missouri Agricultural Experimental Station, Columbia, Missouri

(Manuscript received July 17, 1956)

Loss of weight by beef during the chilling and holding periods is of major concern to the packing industry. Various methods have been used to reduce moisture evaporation by protecting the meat with a bag or wrapper, and by controlling the temperature and relative humidity. Weight loss resulting from trim has partially been eliminated through rapid turn-over of the product. Little is known concerning optimum cooler conditions for holding meat to provide maximum product protection.

A major problem in holding beef at elevated temperatures is to avoid the internal and surface growth of microorganisms of the meat. However, few studies have been reported pertaining to the various aspects of this problem.

Prevention of contamination by stringent hygienic precautions on the slaughtering floor and in the chilling room is of paramount importance in restraining internal and surface microorganisms during aging. This was recognized by Haines *(6)* and other investigators *(1)*. In addition, the physical conditions in the chilling room, sufficient to reduce shrinkage of beef, are also important factors.

For many years, investigators of beef tenderization methods have known that the aging process could be accelerated by raising the temperature. The speed of tenderization was shown by Euell *(5)* to increase at a normal rate; i.e., double for each 18° F. rise in temperature. Growth of bacteria and mold, limited the utility of the more rapid tenderization method at high temperatures.

Investigations were reported by the Mellon Institute *(13, 14)* in 1940, 1941; by Knowles and Reuter *(8)* in 1940; by Rentschler and Nagy *(12)* in 1940; and by McCarthy and King *(10)* in 1942 on the use of germicidal lamps to control microbial growth on the surface of beef being rapidly aged in controlled high temperature—high humidity chambers. The process of rapid tenderization proceeds as a result of high temperature which accelerates the natural enzymatic activity occurring in the tissues. A high humidity in the aging cooler aids in reducing evaporation loss.

This study was concerned with determining: (1) moisture losses due to shrinkage, (2) extent of microbial growth during aging, and (3) trim losses due to surface discoloration. In addition, the influence of (a) length of aging period, (b) grade of beef, (c) temperature, (d) relative humidity, (e) air velocity, and (f) ultraviolet radiation on various organoleptic factors were studied. The present work suggests that optimum environmental conditions are not the same for all meat items.

EXPERIMENTAL PROCEDURE

Experiment 1

Eight Shorthorn cattle, weighing 775 to 800 pounds, were slaughtered at the Missouri Station Laboratory. This group consisted of 3 Choice and 5 Good grade cattle as determined by a committee. Hot carcass weights were recorded at the time of slaughter. Carcasses were then placed in the chill room at 33° F. The right sides of 2 cattle were chilled to an internal temperature of 55° F. and 50° F., respectively. The remaining sides were chilled 24 hours or to an internal temperature of approximately 38° F.

After the initial chilling period, the carcasses were weighed, quartered, and each quarter reweighed. The right quarters of each side were held under ultraviolet radiation for 3 days at 57° F., 80% relative humidity with an air flow of 15 to 20 lineal feet per minute over the product. The intensity of germicidal ultraviolet radiation in the aging cooler varied from 60 to 150 micro watts per square centimeter. The left quarters of each carcass were held 14 days at 40° F., relative humidity of 80% with an air flow of 15 to 20 lineal feet per minute. The aging period did not include the time elapsed from kill date to the conclusion of the chill. At the end of the high temperature aging period, the quarters were removed and placed into a 34° F. chill room for 24 hours prior to processing.

Weight losses were recorded for the first 24 hours and then daily throughout the aging periods. Subjective observations were made of surface discoloration of fat and lean. Effect of ultraviolet intensity and duration of radiation on reducing trimming loss due to microbial growth were determined.

Samples from each treatment were packaged, frozen, and stored at 0° F. These samples consisted of steaks which were removed in the following manner. When necessary, the cut surface of the 12th rib was trimmed followed by removing a ¾-inch steak for initial organoleptic testing. Then a 2-inch steak was removed to obtain the shear value. The adjacent 3 rib steaks (cut ¾ inch thick) were used for 0° F. storage tests of 2, 4, 8, and 12 months, respectively. Top round steaks were removed in the same manner, beginning at the anterior end. The second T-bone steak from the anterior end of the loin was also used for taste panel evaluation.

Organoleptic procedure. The rib, loin and top round steaks were removed from 0° F. storage, placed in a 36° F. cooler and allowed to thaw 24 hours prior to cooking. The weight of each steak was recorded to the nearest gram before and after thawing to obtain drip loss. The gas broiler was preheated one hour to 350° F., using the Micromax Temperature Recorder to regulate the temperature. Thermocouples were placed into the center of each steak and the rise in temperature was recorded. No seasoning was added to the steaks. Steaks were placed on the broiler grill approximately 5 inches from the flame. On reaching an internal temperature of 104° F., the steaks were turned over and allowed to continue broiling to an internal temperature of 160° F. Cooking loss was determined by weights taken prior to and after broiling.

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[a] Presented before the Sixteenth Annual Meeting of the Institute of Food Technologists, St. Louis, Missouri, June 12, 1956.

[b] Journal Series Paper No. 1638, approved by the Director of the Missouri Agricultural Experiment Station.

[c] Financed in part by a Grant from Pasteuray Corporation, St. Louis, Missouri.

[d] Present address: Animal Husbandry Dept., Oklahoma A&M College, Stillwater, Oklahoma.

A one-inch segment was carved from the center of each steak and cut into 6 individual servings for the taste panel. Each member of the committee was served a warm sample from the same relative position of each steak throughout the experiment. Evaluations, using the hedonic scale method, were made for aroma, flavor, juiciness, tenderness, and flavor of fat. These values ranged from a score of 1 *(very undesirable)* to 7 *(very desirable)*.

Warner-Bratzler shear procedure. The cooking procedure for each two inch rib and top round steak was the same as previously described for the organoleptic procedure. One-inch cores were taken from the lateral, center, and medial positions of each steak for shear determinations. Three shear values were determined from each core sample while the samples were at serving temperatures.

Bacteriological procedure. A thin slice from the center of each rib eye was removed with a sterile knife and placed in a sterile petri dish. Fifty grams of lean tissue were weighed, placed in a Waring blender with 450 ml. of sterile water, and blended for 5 minutes. Serial dilutions were made from which duplicate platings were poured for incubation at 15° C. and 37° C.

Experiment 2

This test consisted of average to high U. S. Good paired wholesale ribs from 16 Hereford cattle averaging 1175 pounds. Other than difference in humidity, aging time, and temperature, this study was a replicate of Experiment 1. The relative humidity for each treatment was 90%. The aging temperature was 68° F. for the short time-high temperature box, and the aging time was two days. The temperature of the control aging cooler was 34° F.

RESULTS AND DISCUSSION

Reproducibility of tenderness values for beef quarters and ribs aged 3 days at 57° F. was found to be equal to those aged at 40° F. for 14 days. These values are similar to those reported by Deatherage, *et al. (4)*. The mean and "F" values for palatability committee scores for round, rib, and T-bone steaks are presented in Tables 1, 2, 3, and 4, respectively. An analysis of variance of the taste panel data for each palatability factor showed no significant treatment difference. This indicates that beef aged 2 days at 68° F. was comparable to that aged 14 days at 34° F. (Table 4). Although not significant, there was considerable variation in aroma as shown by the palatability committee between the treated and the control. The difference was in favor of the treated samples. This was possibly due to the effect of the higher temperature in developing certain flavor constituents.

TABLE 1
Mean and F-values of palatability factors for T-bone steaks as determined by taste panel[1]

Palatability factors	Mean value[2]			F-value		
	Treated[3]	S. E.	Control[4]	S. E.	Treatment	Animal
Aroma	4.58±	.1758	4.73±	.1836	.8881	4.5238
Flavor	4.79±	.1368	5.12±	.1361	4.4839	1.9980
Juiciness	4.64±	.3652	4.64±	.3090	.0001	2.1030
Tenderness	5.04±	.3079	4.60±	.3475	.7377	.6619
Flavor of fat	3.62±	.2391	3.35±	.3198	1.1587	4.0224

[1] Taste panel consisted of 6 members.
[2] A hedonic scale with values 1 through 7 was used by the panel to evaluate each sample as to its palatability factor. A score of 7 indicated the most desirable.
[3] Aged 3 days at 57° F. in ultraviolet radiated atmosphere, 80% R. H., air flow 15 to 20 L. F. M.
[4] Aged 14 days at 40° F., 80% R. H., air flow 15 to 20 L. F. M.

In Experiment 1, there were appreciable differences for aroma (Table 2), and flavor (Table 1 and 3). This variation was in favor of the control samples indicating the temperature was too low to promote adequate breakdown of constituents by the proteolytic enzymes. The controls also showed a significant difference (.05 level) for flavor of fat. This difference was due to an excess of ozone and germicidal ultraviolet radiation.

There was a significant relationship (.05 level) existing between animals for tenderness (Table 4), indicating that proper animal selection is an important phase in producing tender beef. Heritability of factors responsible for tenderness has not been studied, but other carcass characteristics have been shown to be transmitted from one generation to the next when proper selection is used [Woodward, *et al. (15)*]. In

TABLE 2
Mean and F-values of palatability factors for rib steaks as determined by taste panel[1]

Palatability factors	Mean value[2]			F-value		
	Treated[3]	S. E.	Control[4]	S. E.	Treatment	Animal
Aroma	4.65±	.0919	4.96±	.1329	3.3495	.7789
Flavor	4.98±	.2074	4.88±	.1657	.2156	1.7517
Juiciness	4.90±	.3203	4.50±	.2676	.9755	1.1637
Tenderness	5.00±	.2653	5.17±	.2629	.1416	.4079
Flavor of fat	3.17±	.2692	3.90±	.1477	7.8237*	1.7897

[1] Taste panel consisted of 6 members.
[2] A hedonic scale with values 1 through 7 was used by the panel to evaluate each sample. A score of 7 indicated the most desirable.
[3] Aged 3 days at 57° F. in ultraviolet radiated atmosphere, 80% R. H., air flow 15 to 20 L. F. M.
[4] Aged 14 days at 40° F., 80% R. H., air flow 15 to 20 L. F. M.
* Significant at .05 level.

TABLE 3
Mean and F-values of palatability factors for round steaks as determined by taste panel[1]

Palatability factors	Mean value[2]			F-value		
	Treated[3]	S. E.	Control[4]	S. E.	Treatment	Animal
Aroma	4.85±	.1995	4.89±	.1724	.0184	.7330
Flavor	4.50±	.2525	4.89±	.1477	3.4511	2.7621
Juiciness	4.50±	.3756	4.73±	.2784	.5818	3.8084
Tenderness	4.35±	.3991	4.52±	.3327	.2086	3.0686
Flavor of fat	4.04±	.2010	3.89±	.2516	.4762	3.6982

[1] Taste panel consisted of 6 members.
[2] A hedonic scale with values 1 through 7 was used by the panel to evaluate each sample as to its palatability factor. A score of 7 indicated the most desirable.
[3] Aged 3 days at 57° F. in ultraviolet radiated atmosphere, 80% R. H., air flow 15 to 20 L. F. M.
[4] Aged 14 days at 40° F., 80% R. H., air flow 15 to 20 L. F. M.

TABLE 4
Mean and F-values of palatability factors as determined by taste panel[1] and shear values for rib steaks

Palatability factors	Mean value[2]			F-value		
	Treated[3]	S. E.	Control[4]	S. E.	Treatment	Animal
Aroma	5.08±	.1684	4.71±	.1068	2.9746	.7004
Flavor	4.71±	.1501	4.74±	.1542	.0238	1.1831
Juiciness	4.48±	.2589	4.45±	.1867	.0965	.9924
Tenderness	4.81±	.2957	4.63±	.2353	.8465	5.3333*
Tenderness[5]	15.54±	.9062	15.82±	.5601	.1365	2.7820
Flavor of fat	3.94±	.2304	3.89±	.1877	.0323	1.6825

[1] Taste panel consisted of 6 members.
[2] A hedonic scale with values 1 through 7 was used by the panel to evaluate each sample as to its palatability factor. A score of 7 indicated the most desirable.
[3] Aged 2 days at 68° F. in ultraviolet radiated atmosphere, 90% R. H., air flow 15 to 20 L. F. M.
[4] Aged 14 days at 34° F., 90% R. H., air flow 15 to 20 L.F.M.
[5] Warner-Bratzler Shear force in pounds.
* Significant at .05 level.

both trials of this study, there was considerable, but not significant, variation between animals for all other palatability factors.

Correlations of shear values for round and rib steaks with the palatability committee scores for tenderness were not statistically significant. This is in agreement with those reported by Branaman, *et al. (3)*, Naumann, *et al. (11)*, and Hedrick *(7)*, who reported a low correlation between taste panel scores for tenderness and Warner-Bratzler shear values. However, Mackintosh, *et al. (9)* and Black, *et al. (2)* reported a high correlation between the shear and palatability committee.

An analysis of variance was used to determine differences among judges and differences due to treatment between judges. Mean and "F" values are also reported for each palatability factor as determined by individual judges (Table 5). There was a significant difference between judges (.05 level) for flavor of fat, indicating that the judges were not consistent in scoring fat samples. In addition, a significant difference (.05 level) for aroma existed due to differences in treatment as influenced by judges.

Table 6 gives the mean and "F" values for thawing (drip), and cooking loss for round, rib and T-bone steaks. The results indicate that rib steaks from wholesale ribs aged 3 days at 57° F. lost more moisture due to thawing than controls aged at 40° F. for 14 days. T-bone steaks from hind-quarters aged at the high temperature lost more moisture during cooking than the controls. However, no treatment difference was found for round and rib steaks for loss due to cooking. The loss of moisture by round steaks during thawing was found to vary with the steaks from different animals. Both thawing and cooking loss for rib and T-bone steaks and cooking loss for round steaks show a consistent variation between animals, however, this difference was not significant.

No difference in thawing and cooking losses between treatment or animal was found to exist in those samples aged at 68° F. and 34° F. (Table 7). This indicates that aging at the higher temperature greatly aided in reducing the weight loss during thawing and cooking.

TABLE 5
Mean and F-values of palatability factors for rib steaks as determined by individual judges

Palatability factors	Mean value[1]			F-value		
	Treated[2]	S. E.	Control[3]	S. E.	Treatment	Judge
Aroma	81.33±	1.6462	75.33±	1.8349	5.5102*	.8639
Flavor	75.33±	2.3476	75.87±	2.7253	.0154	.5990
Juiciness	71.67±	2.0763	71.17±	.9804	.0303	.2781
Tenderness	77.00±	3.2455	74.00±	2.8284	.8385	2.4534
Flavor of fat	63.00±	5.1039	61.67±	3.4785	.1509	5.4830*

[1] Indicates average total of 6 judges' scores for each variable. A score of 112 was possible based on a hedonic scale of 7 points as most desirable with 16 samples in each treatment.
[2] Aged 2 days at 68° F. in ultraviolet radiated atmosphere, 90% R. H., air flow 15 to 20 L. F. M.
[3] Aged 14 days at 34° F., 90% R. H., air flow 15 to 20 L. F. M.
* Significant at .05 level.

TABLE 6
Mean and F-values for thawing (drip) and cooking loss for round, rib, and T-bone steaks

Shrinkage	Mean value[1]			F-value		
	Treated[2]	S. E.	Control[3]	S. E.	Treatment	Animal
Round						
Thawing	2.14±	.443	1.99±	.5086	.2440	8.9363*
Cooking	31.44±	1.8828	31.26±	1.6649	.0077	2.0927
Rib						
Thawing	1.81±	.2022	1.11±	.1431	14.6018**	2.7006
Cooking	25.94±	1.0710	25.11±	.9965	1.0796	4.3836
T-Bone						
Thawing	1.77±	.2656	1.26±	.2276	1.6436	1.8004
Cooking	25.94±	1.2385	23.78±	.1370	7.0831*	4.7220

[1] Based on percentage thawing and cooking loss.
[2] Aged 3 days at 57° F., in ultraviolet radiated atmosphere, 80% R. H., air flow 15 to 20 L. F. M.
[3] Aged 14 days at 40° F., 80% R. H., air flow 15 to 20 L. F. M.
* Significant at .05 level.
** Significant at .01 level.

TABLE 7
Mean and F-values for moisture loss due to thawing and cooking

Shrinkage	Mean value[1]			F value		
	Treated[2]	S. E.	Control[3]	S. E.	Treatment	Animal
Thawing (drip)	.8062±	.1214	.9076±	.0872	.3001	.3100
Cooking (loss)	25.0481±	1.0273	24.8481±	.9875	.1710	.7363

[1] Based on percentage thawing and cooking loss.
[2] Aged 2 days at 68° F. in ultraviolet radiated atmosphere, 90% R. H., air flow 15 to 20 L. F. M.
[3] Aged 14 days at 34° F., 90% R. H., air flow 15 to 20 L. F. M.

Shrinkage, due to moisture evaporation, has been of major concern to the meat industry. However, the literature is very limited in the discussion of this problem. The total accumulative shrinkage of 16 U. S. Good wholesale beef ribs aged 12 days at 34° F. was 4.06%. The average shrinkage was .4% per day indicating that a consistent line relationship is formulated under these cooler conditions (Figure 1). The horizontal line shows the average shrinkage was 1.67% for 16 U. S. Good wholesale beef ribs aged two days at 68° F. This indicates that 1.67% shrinkage for two days at the higher temperature is equivalent to 1.40% shrinkage for 3 days at the lower temperature.

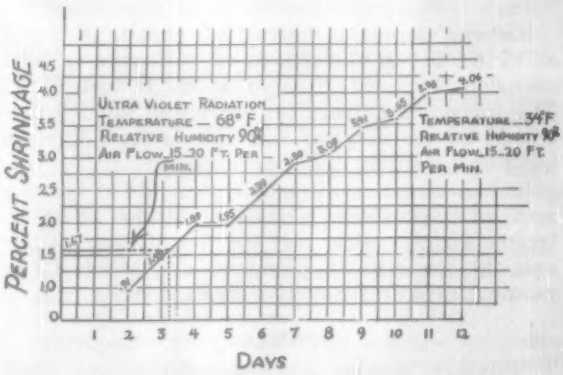

Fig. 1. Accumulative shrinkage for wholesale beef ribs (U.S. good) aged at high versus low temperature.

Trimming loss due to bacterial growth from beef aged at elevated temperatures is also an important consideration. However, under properly controlled environmental conditions, this loss will be minimized.

The rate of increase in the internal temperature of hind quarters previously chilled to 40° F., 50° F., and 55° F., respectively, when held at 68° F., is shown in Figure 2. The temperature of the hind quarters increased rapidly but leveled off at the end of 21 hours at 62-63° F. Fifteen additional hours were required for the temperature to reach 66-67° F. The internal temperature of the wholesale rib increased very sharply during the first 10 hours to 64° F. but only increased 3 degrees during the following 26 hours.

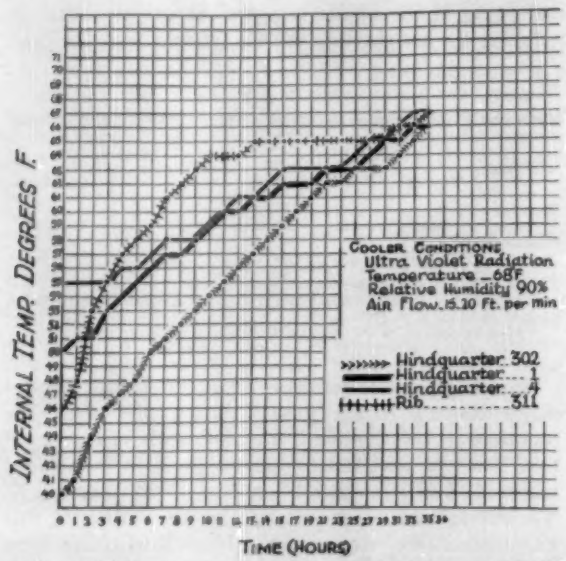

Fig. 2. Rate of temperature increase of wholesale beef rib and hindquarters at 68° F.

Bacterial platings of internal rib samples incubated at 15° C. and 37° C. showed no difference in total microflora between ribs aged at 68° F. and 34° F. This supports the contention that proper sanitary procedures on the slaughter floor and in the chill room assist in minimizing deep seated spoilage.

In Experiment 1, the subcutaneous fat of quarters aged under germicidal ultraviolet radiation at 68° F. became slightly yellow after one day of aging. However, this condition was eliminated in Experiment 2 by raising the relative humidity from 80 to 90%.

SUMMARY

Shrinkage, cooking loss, organoleptic, and shear values have been determined on round, rib, and T-bone steaks from Choice and Good grades of beef aged at 68° F., 57° F., 40° F., and 34° F. This product was aged under relative humidities varying from 80 to 90% and air velocities of 15 to 20 lineal feet per minute. Ultraviolet radiation was used to control microbial growth at the elevated temperatures.

Evidence is reported to substantiate the need for additional research in breeding and selecting animals for tenderness qualities.

Sixteen wholesale beef ribs (U. S. Good), aged 12 days at 34° F., averaged .4% shrinkage per day due to moisture evaporation. The shrinkage for beef ribs aged at 68° F. for 2 days was 1.67% and this was found to be comparable to the amount of moisture loss from ribs aged 3 days at 34° F.

LITERATURE CITED

1. Anonymous. Hygienic methods for the preparation of beef in the meatworks. *Council for Sci. and Ind. Res.*, Australia Section of Food Preservation and Transport, Circ. No. 2 P. (1938).
2. Black, W. H., Hiner, R. L., Burk, L. B., Alexander, L. M., and Wilson, C. V. Beef production and quality as affected by method of feeding supplements to steers on grass in the Appalachian region. U.S.D.A. *Tech. Bull. No. 717* (March 1940).
3. Branaman, G. A., Hankins, O. G., and Alexander, L. M. The relation of degree of finish in cattle to production and meat flavors. *Am. Soc. An. Prod. Record*, 29, 295-300 (1936).
4. Deatherage, F. E., and Reiman, W. Measurement of beef tenderness and tenderization of beef by Tenderay process. *Food Research*, 11, 525-534 (1946).
5. Euell, A. W. The tendering of beef. *Reg. Eng.*, 39-40, 237-240 (1940).
6. Haines, R. B. Microbiology in the preservation of animal tissues. *Food Investigation Special Report*, No. 45, H. M. Stationery Office, London (1937).
7. Hedrick, H. B. Effect of plane of winter nutrition on quality of beef. (*Master's thesis*, University of Missouri, 1955).
8. Knowles, D. D., and Reuter, E. The Sterilamp, its electrical and radiation characteristics. *Trans. Electrochem. Soc.*, 78, 12 (1940).
9. Mackintosh, D. L., Hall, J. C., and Vail, G. E. Some observations pertaining to tenderness of meat. *Am. Soc. An. Prod.*, 29, 285-289 (1936).
10. McCarthy, James F., and King, C. G. Some chemical changes accompanying tenderization of beef. *Food Research*, 7, 295-299 (1942).
11. Naumann, H. D., Brady, D. E., and Dyer, A. J. Methods of evaluating quality in beef. *Proc. Forty-fifth Annual Meeting of the Am. Soc. An. Prod.*, p. 903 (abstract) (1953).
12. Rentschler, H. C., and Nagy, R. Advantages of bactericidal ultraviolet radiation in air conditioning systems. *Heating, Piping, and Air Conditioning*, 12, 127-130 (1940).
13. Researches at Mellon Institute. News Edition, *Am. Chem. Soc.*, 18, 291 (1940).
14. Researches at Mellon Institute. News Edition, *Am. Chem. Soc.*, 19, 395 (1941).
15. Woodward, R. R., Quensenberry, J. R., Clark, R. T., Shelby, C. E., and Hankins, O. G. Relationships between preslaughter and post slaughter evaluations of beef cattle. U.S.D.A. *Circ. No. 945* (May 1954).

Effects of Canning on New and Familiar Sweet Potato Varieties with Particular Emphasis on Breakdown and Firmness[a]

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IN THE LAST 15 YEARS, small whole sweet potatoes packed either in syrup or in vacuum have gained popularity as a canned food. However, one factor has tended to keep their popularity from increasing further: that is, an occasional pack will be encountered in which the canned product has broken down (lost wholeness and firmness) to the extent that it becames unattractive. This is the most frequent complaint from both consumers and canners regarding sweet potato quality.

Product breakdown is nothing new to sweet potato canners; Culpepper and Magoon reported work on this problem in solid pack sweet potatoes as early as 1926 *(2)*. But with the packing of whole sweet potatoes and the general improvement in quality now found in the canned product, the problem of breakdown, when it occurs, becomes more noticeable. Published reports on the cause and prevention of breakdown in canned sweet potatoes are comparatively few, and the findings of various workers have not always been in agreement. Attempts have been made in the past to control the breakdown by changes in canning technique and addition of firming agents, but with limited success. Apparently, the factors affecting breakdown and loss of firmness are varied and more complex than originally suspected.

In their early work, Culpepper and Magoon found that sweet potatoes canned after storage showed a greater tendency to break down than those canned when freshly dug. Others have since found that different varieties show considerable difference in susceptibility to breakdown on canning *(4, 5)*. It has also been found that changes which result in breakdown and softening of the canned product actually take place, to a large extent, before the sweet potatoes are subjected to canning procedures *(1, 3, 4)*.

In recent years many new sweet potato varieties have been developed by state and Federal horticultural groups in an effort to increase the quality of both the fresh market and the canned product *(7, 9, 10, 11)*. It is commonly accepted that certain varieties perform better when grown in certain areas. It has also been found that seasonal variation in climatic conditions may affect the canning quality of a given variety *(4, 5, 6)*.

Several theories prevail among sweet potato canners as to the cause of breakdown—some without factual basis. As a consequence, a number of canners have been using rather questionable canning practices, such as reducing the heat processing time below that recommended as a safe minimum. The work described herein was carried out to obtain information on the true causes of breakdown and to achieve if possible a real solution to this problem. The work was done on canned samples of the same varieties, grown and packed in climatically different localities. Although primary interest was in breakdown, effects on other quality factors were also studied. This work is an outgrowth of the two separate varietal studies carried out in Maryland and Louisiana *(6, 8)*.

[a] Presented at the Sixteenth Annual Institute of Food Technologists Meeting in St. Louis, June 10-14, 1956.

EXPERIMENTAL METHODS

Varieties tested. Nine varieties of sweet potatoes were included in the tests in both areas:

1. Earlyport (L-240), a relatively recent release of Louisiana State University and now being grown commercially to some extent in the Gulf State area.
2. Goldrush (L-241), a somewhat older development of Louisiana State University, rapidly gaining in popularity as a canning variety in the Louisiana area *(7)*.
3. Heartogold, also a development of Louisiana State University, which has been canned to some extent in that area since 1949.
4. Kandee (K-1716), a recently named variety released by Kansas State Experiment Station, which shows some promise as a canning variety.
5. Nemagold (Okla.-46), developed by the Oklahoma Agricultural Experiment Station and raised commercially to some extent in the Maryland area.
6. Orlis (Jersey Orange), another development of the Kansas State Experiment Station, fast becoming the most commonly grown canning variety in the Eastern Shore area, and replacing the old standard canning variety, Maryland Golden.
7. Porto Rico (Unit I), the old standard commercial variety grown in Louisiana and the Gulf State area.
8. Shoreland (Md. 47), a development of Maryland University, grown mostly on an experimental basis in the Maryland area.
9. Sunnyside (B-5944), developed at the Beltsville, Maryland U. S. D. A. Experiment Station and grown for canning to some extent in the Tri-State Eastern shore area.

Source of raw stock. Seed stock for the sweet potato varieties tested in both areas was obtained directly from the originators of the variety with the exception of Shoreland which was obtained from a private grower.

Growing data. Sweet potatoes from Louisiana were grown under the supervision of Louisiana State University personnel on their plots. They were harvested 147 days after planting. During the growing season the average temperature was 77.9° F. and total rainfall was 25.83 inches. The average temperature was above normal for the entire growing period, while the rainfall was 17.16 inches below normal, making that season (1954) the dryest of the 64 years for which records have been kept.

The sweet potatoes from Maryland were grown on a private farm under the supervision of a Continental Can Company horticulturist. They were harvested 137 days after planting. During the growing season, average temperature was 72.1° F. and total rainfall was 20.89 inches. The average temperatures were within 2° F. of the normal but the rainfall was erratic, i.e., was considerably below normal during the first half and considerably above normal during the latter part of the growing period.

Storage of raw stock. Those portions of each test variety not canned immediately were stored under commercial conditions in both growing areas before being canned.

In Louisiana a portion of test varieties was stored for one month at an average temperature of approximately 77° F.; the remainder for a total of 3 months. Average temperature during this entire storage period was approximately 71° F.

In Maryland, a portion was held in storage for one month only at an average temperature of approximately 77° F.

Canning. All samples were canned in their growing area on commercial equipment under standard conditions in commercial canning plants.

In Louisiana 3 test packs were made. The first pack was made using freshly dug sweet potatoes; the second using sweet potatoes that had been stored for one month; and the third using sweet potatoes that had been in storage for 3 months.

In Maryland only two test packs were made—one using freshly dug sweet potatoes and one using sweet potatoes which had been stored for one month. An attempt was made to keep cannnig procedure as uniform as possible in the two areas. However, some variation in canning procedure was unavoidable, as the packs were made in canning plants where differences in equipment and general practice limited the packing procedures. The packing procedures varied mainly in that the Maryland sweet potatoes were steam peeled (50 seconds at 100 p.s.i. pressure) while lye peeling (20 to 22% at 220° to 230° F. for 6½ to 8 minutes) was used in the Louisiana area.

All sweet potato varieties were canned both in syrup pack and vacuum pack styes at each location; the syrup pack in 25° to 30° Brix syrup and the vacuum pack in a vacuum equivalent to 26 to 30 inches of mercury.

The samples were packed in 404 x 307 cans and heat processed at 240° F. for the length of time considered adequate for the respective area in which they were packed.

Evaluation. Following recommended commercial practice, canned samples were held undisturbed at the canner's plant for 10 to 14 days after being packed to permit firming of the product before shipment. They were then shipped to our Chicago laboratory for examination and storage. Samples of each variable were examined periodically for one year after being canned in order to determine whether storage after canning would have any marked effect on the quality of the canned sweet potatoes. While some variation was found between the results of the periodic examinations, no definite trends in quality change were evident. As a consequence, it appeared more worthwhile to the basic purpose of the study to report the average of the various examinations. It was not possible in all instances to examine the same number of samples of each variable as lower than anticipated yields of a few varieties limited the number of samples available.

In examining the samples, the puncture vacuum, net weight, syrup density and headspace or fill were checked to insure that the sample was normal. The sweet potatoes were then scored for firmness, wholeness, texture, color and flavor using the rating scale shown in Table 1.

RESULTS AND DISCUSSION

Averages of the data obtained from all quality examinations of the canned samples of test sweet potatoes are presented in Tables 2 and 3. These data were not statistically analyzed, because the averages were not obtained from the same number of samples in all instances. As stated previously, the number of samples evaluated was less than the number hoped for in some varieties due to smaller than anticipated yields. Examinations of some variables terminated before the completion of a year's storage due to extremely poor quality ratings at initial examinations. However, the data do show definite trends which are of some consequence in this type of study involving a single canning season.

From these results it can be observed that, with the exception of one variety, there are only minor differences between the texture of samples of the test varieties grown in either area whether canned when freshly dug or after being stored. Shoreland variety, the exception, showed significantly poorer texture in the Louisiana grown sample than in the samples from Maryland. Since this variety gave a poor yield in Louisiana, and only a limited number of samples was available for examination, it is quite possible that the average texture figures are not as accurate as those recorded for the other varieties.

Texture ratings for these studies were based on the degree of fiber present (Table 1). The amount of fiber in a sweet potato varies with its size and development, the smaller roots often being the more fibrous. Since the quantities of all varieties available for use in these tests were limited, size grading could not be done to insure uniformly sized sweet potatoes for all cans of a variety. As a result, texture ratings showed variations within all variables, but where sufficient samples were present they gave reliable averages. However, in varieties which yielded poorly so that only a limited number of samples could be canned, as did Shoreland, it is quite conceivable that average texture figures could be inaccurate.

It was not surprising that there was little difference in texture ratings between samples of sweet potatoes canned when freshly dug and those canned after storage since storage causes little change in fiber content. However, it was rather unexpected that there was so little difference in the texture between the same varieties grown in the two different areas.

In discussing flavor, it must be kept in mind that the flavor ratings as used in these tests refer to the degree of pleasant taste (Table 1) rather than differences in characteristic flavor. Some differences in the charac-

TABLE 1

Scores for canned sweet potatoes

Color rating		Firmness rating[3]	Wholeness rating[4]	Texture rating[5]	Flavor rating[6]
Hue[1]	Uniformity[2]				
1-2 Yellow	1-2 Poor	1-4 Mushy	0 Comp. breakdown	1-6 Fibrous	1-4 Poor
3-5 Lt. Gold	3-4 Fair	5-8 Soft	1-5 Considerable loss	7-12 Sl. stringy	5-8 Fair
6-8 Gold	5-6 Good	9-12 Sl. soft	6-10 Moderate loss	13-18 Occasionally str.	9-12 Good
9-10 Dp. Orange	7-8 V. Good	13-16 Fairly firm	11-15 Slight loss	19-20 Prac. no fiber	13-16 V. good
	9-10 Excel.	17-20 Firm	16-20 Practically whole		17-20 Excel.

[1] Color (hue)—actual color of samples.
[2] Color (uniformity)—variation of color in the same or different units within a given sample.
[3] Firmness—variation in character of the units from mushiness to firmness.
[4] Wholeness—degree of freedom from breakdown or cracking of units.
[5] Texture—variation in degree of fiber present.
[6] Flavor—degree of pleasant taste.

TABLE 2

Comparative quality ratings of syrup packed sweet potatoes grown in two test areas. (Scores represent grand averages of all examinations over a one-year period)

Variety	Pack[1]	No. of exams.		Firmness		Wholeness		Color		Texture		Flavor	
		La.	Md.	La.	Md.	La.	Md.	La.	Md.	La.	Md.	La.	Md.
Earlyport	F	15	5	12.5[2]	17.4[2]	18.6	18.9	15.8	13.3	14.9	15.5	15.6	14.8
	1	12	0	15.7		16.0		14.2		15.5		14.0	
	3	12		15.8		16.2		14.0		14.8		12.9	
Goldrush	F	15	4	17.2[2]	18.3	17.5	19.0	18.3	16.9	17.4	17.0	14.8	16.5
	1	12	7	8.9	13.6	13.5	17.4	17.6	15.2	15.3	17.5	14.4	15.4
	3	12		11.0		16.6		17.9		16.3		14.8	
Heartogold	F	15	15	18.7	17.2	16.2	16.0	16.5	14.5	16.0	15.2	14.5	13.8
	1	9	12	5.6	14.3	5.6	14.0	16.4	15.8	15.0	14.3	14.9	15.1
Kandee	F	15	11	12.2[2]	16.6[2]	18.5	18.9	15.6	16.8	14.2	13.3	15.5	13.7
	1	12	12	16.5	16.8	17.2	18.8	17.5	16.2	12.8	14.4	14.5	15.1
	3	12		17.0		16.1		14.4		14.1		14.9	
Nemagold	F	15	15	16.2	12.4	16.4	11.5	14.3	16.4	13.2	12.9	13.9	14.0
	1	11	12	15.0	12.5	15.6	12.4	15.0	15.8	10.0	13.1	13.9	14.9
	3	10		15.6		17.0		16.2		10.7		13.5	
Orlis (Jersey Orange)	F	13	15	14.0	15.5	8.5	15.6	7.2	13.6	13.0	14.4	13.6	13.5
	1	0	12		14.7		14.9		15.2		14.0		15.4
Porto Rico	F	15	15	17.9	17.6	17.9	17.1	17.3	11.1	16.0	17.2	14.1	14.5
	1	12	12	7.7	15.8	11.0	18.2	16.1	12.8	14.3	17.5	13.8	15.4
	3	13		10.3		15.4		15.7		15.5		14.5	
Shoreland	F	15	5	16.3	17.1	15.3	16.8	15.6	16.3	11.6	14.3	15.3	13.5
	1	12	9		17.4		17.1	17.2	15.6		14.7		14.3
Sunnyside	F	15	15	16.5	18.4	17.9	17.7	15.7	15.1	16.4	14.2	15.5	14.3
	1	11	12	16.3	18.2	17.1	17.8	13.9	14.6	14.8	17.2	14.9	14.9
	3	10		16.6		17.4		15.5		13.8		14.6	

[1] Pack: F = packed when freshly dug; 1 = packed after one month in commercial storage; 3 = packed after three months in commercial storage.
[2] Score lowered because of excess firmness.

TABLE 3

Comparative quality ratings of vacuum packed sweet potatoes grown in two test areas. (Scores represent grand averages of all examinations over a one-year period)

Variety	Pack[1]	No. of exams.		Firmness		Wholeness		Color		Texture		Flavor	
		La.	Md.	La.	Md.	La.	Md.	La.	Md.	La.	Md.	La.	Md.
Earlyport	F	15	7	17.3[2]	17.4[2]	17.5	16.8	14.9	13.9	14.7	16.5	12.0	12.7
	1	12	0	11.3		11.8		14.5		15.1		13.5	
	3	12		11.0		12.7		12.4		15.5		12.7	
Goldrush	F	15	5	15.4	17.2	14.9	15.0	18.5	15.3	15.1	17.0	13.5	12.4
	1	10	7	0.0	9.5	0.0	10.9	18.8	14.5	.....[3]	15.8	14.8	14.2
Heartogold	F	15	15	16.7	17.0[2]	15.9	17.1	15.1	15.8	15.2	12.5	12.4	11.7
	1	6	12	1.0	15.0	1.0	14.2	17.2	14.1	.....[3]	14.0	14.0	13.2
Kandee	F	15	11	14.3[2]	16.6[2]	17.8	16.2	13.8	16.2	13.6	13.2	12.3	12.3
	1	3	12	10.3	16.8	13.0	17.4	17.2	16.5	16.0	15.1	13.9	13.5
	3	12		13.4		14.2		15.6		15.9		13.8	
Nemagold	F	15	15	15.3	11.7	14.5	9.5	10.9	16.7	11.8	12.3	11.3	11.9
	1	10	12	12.7	10.3	13.8	10.0	12.8	13.7	12.3	11.5	12.9	13.4
	3	10		10.1		11.6		16.1		11.4		11.1	
Orlis (Jersey Orange)	F	14	15	17.8	15.5	14.8	12.3	10.0	14.9	15.7	13.3	11.3	12.2
	1	0	12		9.6		10.7		13.1		12.2		12.5
Porto Rico	F	15	15	15.5	16.3	13.1	15.5	16.4	11.6	14.7	17.0	13.2	12.1
	1	0	12		12.5		13.7		11.7		16.2		13.9
Shoreland	F	5	15	18.2	16.8	15.9	15.1	14.7	15.9	10.0	14.8	12.4	12.1
	1	9	12	17.2	17.2	16.4	15.5	11.6		14.5	14.4	12.5	14.1
Sunnyside	F	15	15	17.5	13.6	17.6	11.4	16.3	15.1	14.7	13.2	12.9	13.9
	1	11	12	10.5	14.9	10.2	13.7	15.6	15.9	15.7	11.3	13.7	13.7
	3	10		11.5		12.4		16.3		16.1		14.1	

[1] Packs: F-packed when freshly dug; 1-packed after one month in commercial storage; 3-packed after three months in commercial storage.
[2] Score lowered because of excess firmness.
[3] Samples so badly broken down that no texture evaluation was made.

teristic flavor of the varieties tested did occur, but because personal taste preferences differ, these do not show up in the average of the flavor ratings given by the taste panel.

The flavor rating average of syrup packed samples of a given variety from either growing area showed very little difference. This was true both of samples packed when freshly dug and those packed after storage.

The vacuum packed variables also showed very little difference in average flavor ratings. However, vacuum-packed samples of storage potatoes of the majority of the test varieties showed very slightly higher

flavor ratings than those packed when freshly dug. This suggests that the sugar in the syrup may have some slight masking effect on flavor differences that might develop in sweet potatoes during storage.

In the majority of instances, syrup-packed variables were given higher flavor ratings than the corresponding vacuum packs. This was to be expected, as the addition of sugar usually imparts a more pleasant taste sensation.

Color differences between the sweet potato varieties tested was to be expected even though these varieties had been chosen originally because of their good color characteristics. In scoring color, the average color ratings recorded in Tables 2 and 3 were based on the combined ratings for hue and uniformity of color as given in Table 1.

With the exception of 3 varieties, there was very little consistent difference in the color ratings within any given variety when grown in either test area. Goldrush and Porto Rico varieties grown in Louisiana showed slightly better color in the canned product than the same varieties grown in Maryland. On the other hand, Orlis variety grown in Louisiana showed a bright yellow color in comparison to the good golden color of the canned Maryland samples. Differences in the color ratings of a given variety whether canned before or after being stored were inconsistent.

In examining these samples, it soon became evident that firmness and wholeness were the two quality factors most affected by variations in test conditions. These factors not only differed between variables, but also showed considerable difference between results from some individual examinations of the same variables. The average results in Tables 2 and 3 do not indicate this variation between examinations. In Tables 4, 5, 6, and 7, the average results for the firmness and wholeness ratings respectively are shown together with the ranges of the individual sample scores for each variety.

In discussing firmness the statements are based on the data shown in Tables 4 and 5 as well as the results in Tables 2 and 3. Similarly, the statements made in discussing wholeness are based on the data shown in Tables 6 and 7, as well as Tables 2 and 3.

Firmness of sweet potatoes canned when freshly dug, either as syrup or vacuum packs, was affected very little by the area in which the raw product was grown. Exceptions were the Maryland samples of Nemagold, packed either in syrup or vacuum, and Sunnyside when vacuum packed which showed slightly poorer average firmness ratings than coresponding Louisiana samples. However, of the 6 varieties grown in both areas and canned after storage, three (Goldrush, Heartogold, and Porto Rico) showed poorer firmness in the Louisiana samples and one (Nemagold) showed poorer firmness in the Maryland samples when syrup packed. When vacuum packed, all but one variety showed poorer firmness in the Louisiana samples. Vacuum packed samples of Shoreland canned after storage showed little difference in firmness regardless of the growing area.

A comparison of the firmness of syrup packed versus vacuum packed variables showed that in sweet potatoes canned when freshly dug there was very little difference in the average firmness ratings for a given variety packed in either style. In the sweet potatoes canned after storage, all of the 6 varieties put up in Louisiana as vacuum packs and four (Goldrush, Orlis, Porto Rico, and Sunnyside) of the 8 varieties vacuum-packed in Maryland showed definitely poorer firmness than corresponding syrup-packed samples.

TABLE 4

Comparative firmness ratings of syrup packed sweet potatoes

Variety	Louisiana packs									Maryland packs					
	Freshly dug			1 mo. storage			3 mo. storage			Freshly dug			1 mo. storage		
	High	Low	Avg.	High	Low	Avg.	High	Low	Avg.	High	Low	Avg.	High	Low	Avg.
Earlyport	14.0[1]	12.0[1]	12.5[1]	18.0	12.0	15.7	18.0	13.0	15.8	19.0	16.0[1]	17.4[1]	not run		
Goldrush	19.0	16.0	17.2	10.0	6.0	8.9	12.0	8.0	11.0	19.0	17.0	18.3	17.0	12.0	13.6
Heartogold	19.0	16.0	18.1	14.0	0.0	5.6	not run			18.0	16.0	17.2	18.0	9.0	14.3
Kandee	13.0[1]	12.0[1]	12.2[1]	18.0	16.0	16.5	19.0	16.0	17.0	19.0	15.0[1]	16.6[1]	19.0	16.0	16.8
Nemagold	19.0	12.0	16.2	18.0	12.0	15.0	18.0	12.0	15.6	16.0	8.0	12.4	17.0	10.0	12.5
Orlis	18.0	8.0	14.0	not run			not run			18.0	10.0	15.5	17.0	13.0	14.7
Porto Rico	19.0	15.0	17.9	10.0	4.0	7.7	12.0	0.0	10.3	18.0	17.0	17.6	18.0	12.0	15.8
Shoreland	17.0	16.0[1]	16.3[1]	not run			not run			18.0	16.0	17.1	19.0	16.0	17.4
Sunnyside	17.0	16.0	16.5	18.0	15.0	16.3	18.0	15.0	16.6	20.0	15.0	18.4	19.0	15.0	18.2

[1] Score reduced because of excessive firmness.

TABLE 5

Comparative firmness ratings of vacuum packed sweet potatoes

Variety	Louisiana packs									Maryland packs					
	Freshly dug			1 mo. storage			3 mo. storage			Freshly dug			1 mo. storage		
	High	Low	Avg.	High	Low	Avg.	High	Low	Avg.	High	Low	Avg.	High	Low	Avg.
Earlyport	19.0	14.0[1]	17.3[1]	15.0	8.0	11.3	14.0	8.0	11.0	19.0	16.0[1]	17.4[1]	not run		
Goldrush	18.0	11.0	15.4	0.0	0.0	0.0	not run			20.0	14.0	17.2	12.0	5.0	9.5
Heartogold	18.0	14.0	16.7	4.0	0.0	1.0	not run			19.0	16.0	17.0[1]	17.0	13.0	15.0
Kandee	16.0[1]	12.0[1]	14.3[1]	15.0	8.0	10.3	15.0	12.0	13.4	19.0	15.0	16.6	19.0	16.0	16.8
Nemagold	18.0	11.0	15.3	14.0	10.0	12.7	14.0	9.0	10.1	16.0	7.0	11.7	16.0	8.0	10.3
Orlis	18.0	16.0[1]	17.8	not run			not run			20.0	10.0	15.5	14.0	7.0	9.6
Porto Rico	18.0	8.0	15.5	not run			not run			18.0	10.0	16.3	15.0	11.0	12.5
Shoreland	19.0	16.0	18.2	18.0	15.0	17.2	not run			19.0	12.0	16.8	19.0	16.0	17.2
Sunnyside	19.0	16.0[1]	17.5	13.0	8.0	10.5	14.0	11.0	11.5	16.0	9.0	13.6	18.0	12.0	14.9

[1] Score reduced because of excessive firmness.

The adverse effect of storage prior to canning on firmness was also evident from these results. In the syrup-packed variables, 3 of the 7 varieties canned after storage in Louisiana and 2 of the 8 varieties canned in Maryland showed poorer firmness than the same varieties packed when freshly dug. Varieties showing poorer firmness included Goldrush and Heartogold grown in both areas and Porto Rico grown in Louisiana. When stored sweet potatoes were canned as vacuum packs, 6 of the 7 varieties packed in Louisiana and 3 (Goldrush, Orlis, and Porto Rico) of 8 varieties packed in Maryland showed substantially lower firmness ratings than were shown in samples of the same varieties canned when freshly dug. Shoreland variety was the one exception in Louisiana, but as previously pointed out, there were so few samples of this variety available that it is impossible to be sure the samples examined were representative.

While there were slight variations between the firmness ratings of samples held in storage for one or 3 months before being canned, there was no indication of any correlation between length of storage period and change in firmness ratings of the canned product. This also was true of the wholeness ratings.

The wholeness of 3 of the 9 varieties grown in both areas and canned when freshly dug seemed definitely affected by the growing conditions in the test areas. Poorer average wholeness ratings were shown by Maryland-grown samples of Nemagold packed in both syrup and vacuum and in Sunnyside and Orlis in vacuum packs. However, in Louisiana, Orlis packed in syrup showed the poorer average wholeness. In the 7 varieties canned in both areas after storage, 5 showed some effect of the growing conditions on the wholeness of the product. When grown in Maryland, Nemagold packed in both styles showed poorer wholeness ratings, whereas samples of Porto Rico in syrup packs, Kandee and Sunnyside in vacuum packs, and Goldrush and Heartogold in both styles showed poorer wholeness ratings when grown in Louisiana.

Style of pack showed an obvious effect on the wholeness of the canned product. In the majority of varieties tested the vacuum-packed variables, whether canned before or after being stored, showed lower average wholeness ratings than the corresponding syrup packs. This difference was not very great in some instances but the trend was definite. The only variety which did not seem to follow this pattern was Heartogold.

Effect of storage was quite evident when the wholeness ratings of sweet potatoes canned when freshly dug were compared with those of samples canned after storage. Poorer average wholeness ratings in variables canned after storage—than those in the corresponding variables canned when freshly dug—were shown by 6 of the 7 varieties canned in Louisiana and by 4 of the 8 varieties canned in Maryland. Varieties which showed the lower ratings in Louisiana were Goldrush, Heartogold and Porto Rico in both vacuum and syrup packs, and Earlyport, Kandee and Sunnyside in vacuum packs. In Maryland samples, only the vacuum packed samples of Goldrush, Heartogold, Orlis and Porto Rico showed lower average wholeness ratings although some individual samples of Heartogold, syrup-packed after storage, showed very poor wholeness.

As would be expected, results showed that, in general, loss of firmness and wholeness occurred to a similar degree in the same variables. There were a few exceptions, however. In these few instances, loss of firmness occurred without noticeable loss of wholeness or vice versa. When loss of firmness occurs without loss of wholeness, it is usually because the canned product has received very careful handling and no

TABLE 6

Comparative wholeness ratings of syrup packed sweet potatoes

Variety	Louisiana packs									Maryland packs					
	Freshly dug			1 mo. storage			3 mo. storage			Freshly dug			1 mo. storage		
	High	Low	Avg.	High	Low	Avg.	High	Low	Avg.	High	Low	Avg.	High	Low	Avg.
Earlyport	20.0	15.0	18.6	20.0	14.0	16.6	18.0	12.3	16.2	19.0	18.0	18.9	not run		
Goldrush	19.0	14.0	17.5	18.0	6.0	13.5	18.0	16.0	16.6	20.0	18.0	19.0	18.0	16.0	17.4
Heartogold	19.0	12.0	16.7	12.0	0.0	5.6	not run			18.0	11.0	16.0	18.0	6.0	14.2
Kandee	20.0	16.0	18.5	18.0	15.0	17.2	19.0	10.0	16.1	20.0	17.0	18.9	19.0	17.0	18.8
Nemagold	18.0	10.0	16.4	18.0	10.0	15.6	18.0	15.0	17.0	16.0	5.0	11.5	16.0	10.0	12.4
Orlis	15.0	4.0	8.5	not run			not run			18.0	10.0	15.6	18.0	11.0	14.9
Porto Rico	19.0	14.0	17.9	18.0	2.0	11.0	17.0	13.0	15.4	19.0	14.0	17.1	19.0	16.0	18.2
Shoreland	18.0	14.0	15.3	not run			not run			18.0	14.0	16.8	19.0	15.0	17.1
Sunnyside	19.0	16.0	17.9	19.0	15.0	17.1	19.0	14.0	17.4	19.0	16.0	17.7	19.0	15.0	17.8

TABLE 7

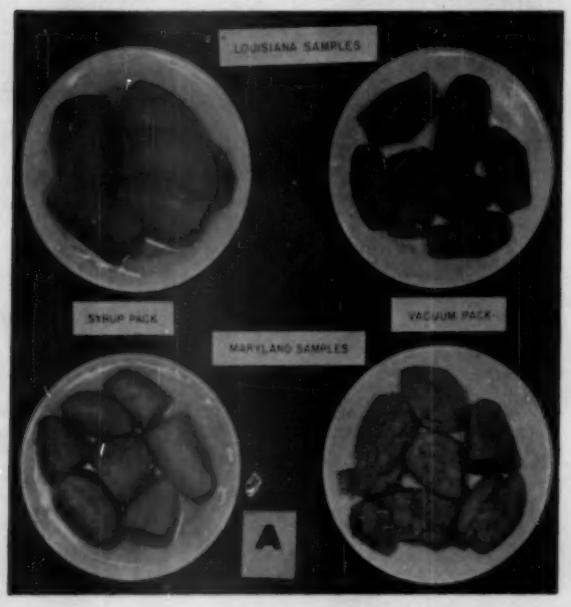
Comparative wholeness ratings of vacuum packed sweet potatoes

Variety	Louisiana packs									Maryland packs					
	Freshly dug			1 mo. storage			3 mo. storage			Freshly dug			1 mo. storage		
	High	Low	Avg.	High	Low	Avg.	High	Low	Avg.	High	Low	Avg.	High	Low	Avg.
Earlyport	18.0	16.0	17.5	15.0	9.0	11.8	17.0	8.0	12.7	18.0	16.0	16.8	Insufficient sample		
Goldrush	18.0	6.0	14.9	0.0	0.0	0.0	not run			18.0	10.0	15.0	14.0	8.0	10.9
Heartogold	20.0	14.0	15.9	4.0	0.0	1.0	not run			19.0	14.0	17.1	17.0	10.0	14.2
Kandee	19.0	16.0	17.8	16.0	5.0	13.0	15.0	10.0	14.2	18.0	14.0	16.2	18.0	15.0	17.4
Nemagold	18.0	10.0	14.5	15.0	7.0	13.8	18.0	6.0	11.6	18.0	4.0	9.5	13.0	8.0	10.2
Orlis	16.0	11.0	14.8	not run			not run			18.0	8.0	12.3	15.0	8.0	10.7
Porto Rico	18.0	5.0	13.1	not run			not run			17.0	10.0	15.5	17.0	10.0	13.7
Shoreland	18.0	11.0	15.9	19.0	14.0	16.4	not run			18.0	11.0	15.1	18.0	14.0	15.5
Sunnyside	19.0	14.0	17.6	15.0	5.0	10.2	16.0	10.0	12.4	17.0	6.0	11.4	16.0	11.0	13.7

mechanical breakdown has resulted. Canned sweet potatoes which have lost a considerable degree of firmness can lose wholeness very easily if subjected to rough handling. Since rough handling is hard to avoid during shipping and warehousing operations, canned sweet potatoes with poor firmness have little chance to arrive at their ultimate destination without losing wholeness as well. On the other hand, loss of wholeness occasionally was evident in canned sweet potatoes showing little or no loss in firmness. This occurred because loss of firmness is involved only where loss of wholeness is caused by sloughing or mechanical damage. When loss of wholeness due to cracking of the sweet potatoes is involved, the broken pieces often show little loss of firmness. However, whether breakdown was caused either by loss of firmness or wholeness this study shows that the amount of breakdown evident in canned sweet potatoes is governed to varying degrees by variety, area in which grown, style of pack, and storage of raw product. The degree to which the breakdown in a given variety is affected by any one of the other factors apparently differs considerably for each variety studied. Illustrations of the effect of these factors in canned sweet potatoes are shown in Figure 1 (A, B, C).

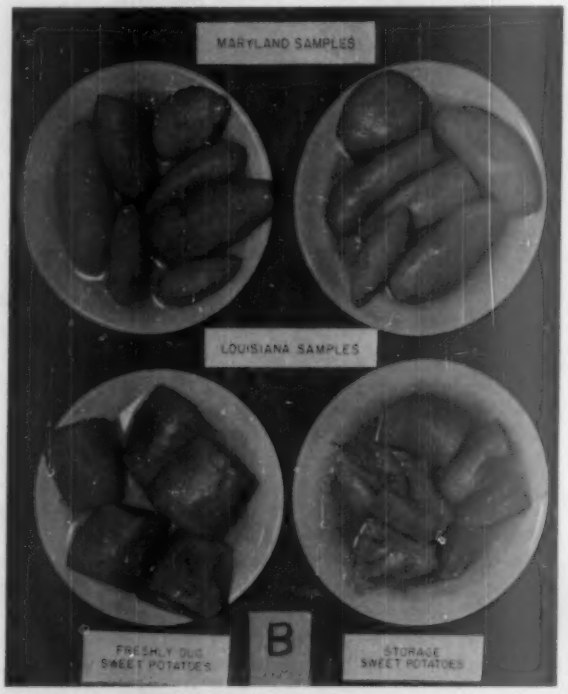
Since these results cover only one season's work, and since seasonal variations in climatic conditions affect the canning characteristics of sweet potatoes *(2, 10)*, the fact that certain varieties show up well under one season's growing conditions should not be taken to mean that they will maintain the same canning characteristics under all growing conditions encountered in a given locality. Varietal studies over several years would be necessary to show specific seasonal effects on sweet potatoes.

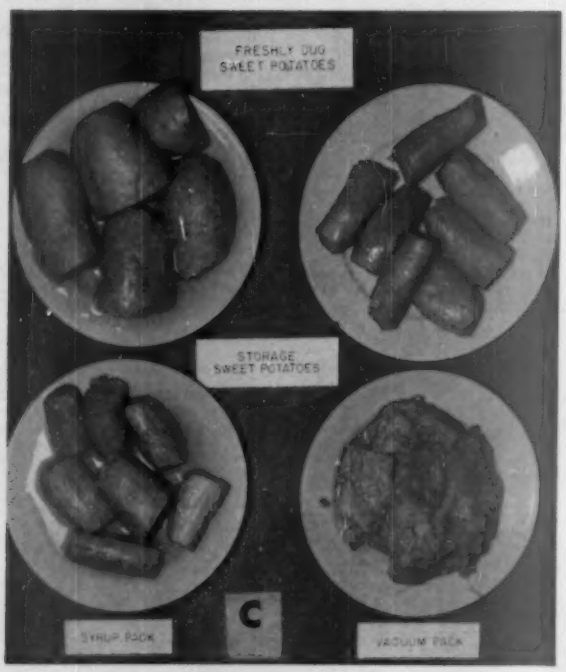
Figure 1. Various factors which may contribute to breakdown in canned sweet potatoes: (A) Effect of style and growing conditions on a single variety (Sunnyside) canned when freshly dug; (B) Effect of storage and growing conditions on a single variety (Porto Rico) canned in a single style (syrup pack); (C) Effect of style and storage on a single variety (Goldrush) grown and canned in a single area (Louisiana).



SUMMARY AND CONCLUSION

Nine canning varieties of sweet potatoes were grown under known conditions in two climatically different areas of this country. After harvesting, respective portions of these varieties were canned when freshly dug and after definite periods in commercial storage. The





sweet potatoes were canned as syrup pack and as vacuum pack using commercial methods and equipment. Samples of the canned sweet potatoes were examined periodically up to 12 months after being canned.

Results of these examinations indicate:

1. Color of the canned product seems to be affected most by the variety and conditions under which the sweet potatoes were grown. Style of pack and storage of the raw stock seemed to have little effect on color.
2. Texture as judged by the amount of fiber in canned sweet potatoes differed with the variety, but seemed to be affected litle, if any, by the style of pack, storage of the raw stock, or area in which grown.
3. Flavor of canned sweet potatoes varies with the variety and seems to be less affected by storage of the raw stock or area in which grown. However, flavor differences were far less obvious in syrup packs containing 25% or more sugar than vacuum packs.
4. Firmness of canned sweet potatoes was affected to varying degrees by variety, style of pack, storage of raw stock, and area in which grown.
5. Wholeness of canned sweet potatoes was affected to a similar degree by variety, style of pack, storage of raw stock and area in which grown. However, in a single variable, firmness and wholeness were not always affected by the same factors to the same degree.
6. Variety, storage of raw stock, and growing area seemed to have more adverse effect on vacuum-packed sweet potatoes than on the syrup-packed product.
7. Results show that breakdown due to excessive loss of firmness and/or wholeness is the quality factor most difficult to control in canned sweet potatoes. This agrees with commercial experience.

The importance of variety, packing style, growing conditions, and storage of raw product are quite evident. Knowing the importance of these factors may help predict a little more accurately the canning behavior of the varieties studied under different climatic and storage conditions. It also suggests the possibility of appreciably controlling breakdown by using sweet potato varieties with known canning characteristics when grown in the area of operation. Such a program would require good grower-broker-canner cooperation and would take considerable development but if successful should result in substantial savings to the canner and a wider popularity of the canned product.

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LITERATURE CITED

1. Artschwager, Ernest. On the anatomy of the sweet potato root, with notes on internal breakdown. *J. Agri. Res.*, **27**, 157-171 (1924).
2. Culpepper, C. W., and Magoon, C. A. The relation of storage to the quality of sweet potatoes for canning purposes. *J. Agri. Res.*, **33**, 627-643 (1926).
3. Deonier, Marshall T., Steinbauer, C. E., Kimbrough, W. D., and Wright, R. E. Cooperative studies on delayed harvesting of sweet potatoes. U. S. Dept. of Agri. *Circ. 841* (1950).
4. Giggard, E. D. A study of factors affecting breakdown and firmness of canned sweet potatoes. (Doctorate thesis, University of Maryland, 1954).
5. Huffington, Jesse M., Giggard, E. D., Steinbauer, C. E., and Walls, E. P. Sweet potato varieties for canning. *Proc. Am. Soc. Hort. Sci.*, **61**, 487-593 (1953).
6. Huffington, Jesse M., McConnell, E. R., and Gottschall, P. B. Sweet potato varieties for canning: Influence of storage on quality. *Proc. Am. Soc. Hort. Sci.*, **67**, 504-513 (1956).
7. Miller, J. C., Mikell, J. J., Fontenat, J. F., Hernandez, T. P., and Attaya, Rita B. A better sweet potato—Goldrush. *Southern Seedsman*, October, 1951.
8. McConnell, E. R., Gottschall, P. B., and Huffington, J. M. Influence of variety and storage on canned Louisiana sweet potatoes. *Proc. Am. Soc. Hort. Sci.*, **67**, 493-503 (1956).
9. McLean, F. T. Breeding new sweet potatoes. Trans. Penin. Hort. Soc. Bull., State Bd. of Agri., Dover, Del., **41**, 41-43 (1951).
10. Steinbauer, C. E. Better sweet potato varieties on the way. *Market Growers' J.*, **81**, 12-13, 45 (1952).
11. White, T. H. Origin and development of the Maryland Golden Sweet Potato. Ann. Rpt. Md. Veg. Gro. Ass'n., 1949.

Effect of Cucumber Holding Time and Temperature on the Quality of Pasteurized Fresh Whole Pickles[a, b]

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DEVELOPMENT OF THE FRESH CUCUMBER PICKLE [described by Fabian and Switzer *(2)*], and the growing demand for this product has resulted in radical changes in many operating procedures of the pickle industry. As the quantity of glass-packed fresh cucumber pickles has increased, attention has been focused on the quality problem as related to appearance. Dirty, scuffed-appearing skin areas and an unnatural color have particularly troubled processors. Since the scuffed areas have the appearance of a scrape or other skin damage, processors have attributed this defect to rough handling; however, holding cucumbers too long after harvest and before processing also has been observed to cause quality deterioration. Before this quality problem can be eliminated, the causative factors must be determined and evaluated. The purpose of this experiment was to determine the relationship between the time and temperature at which fresh cucumbers were held and the quality of the resultant pickles.

EXPERIMENTAL METHODS

The experiment was designed as a split plot factorial with the major split for time of harvest and a second split for holding temperature. The latter was a precaution against possible variations of the holding conditions.

Ten bushels of cucumbers of the variety SR-6 measuring 1 1/16 to 1 1/4 inches in diameter were obtained on two harvest dates from a commercial field, brought into the laboratory and divided into 10 representative lots. Cucumbers in one lot were immediately packed while the remaining 9 lots were randomized and placed in temperature controlled rooms. Samples for all holding times were completely randomized in each room. Relative humidity in the rooms was not controlled and varied from 60 to 85%. Cucumbers were held before packing as indicated below:

Lot number	Holding time after grading hours	Holding temperature ° F.
1	0	Control
2	24	40
3	24	60
4	24	80
5	48	40
6	48	60
7	48	80
8	72	40
9	72	60
10	72	80

At the conclusion of the storage period, 12 jars of whole fresh dill cucumber pickles were packed from each lot.

Procedure used in packing the cucumbers was essentially that outlined by Esselen *et al. (1)*. The fresh cucumbers were soaked for 20 minutes in 120° F. water, drained, and placed in 32 oz. glass jars; one ml. of a mild kosher dill essential oil mixture[c] was added to each jar after which they were filled with a brine containing 12 grains (1.2%) acid and 5% salt. The jars of cucumbers were pasteurized in a 180° F. water bath for 40 minutes and cooled with a cold water spray. Jars were stored at room temperature in closed cases.

Four months after packing, 200 jars (10 jars from each treatment for each harvest) were rated for "in-the-jar" quality. Five jars of pickles which were subjectively judged *excellent, good, fair, poor* and *very poor* and numerically rated 9, 7, 5, 3 and 1, respectively, were used as standards. The experimental pickles were evaluated and numerically rated by comparing each jar with the standards. F tests were made with individual degrees of freedom to determine whether or not the relationships of quality to holding temperature and holding time were linear.

Eight months after packing, the pickles were evaluated for color, skin texture, flavor, and acceptability for commercial use. A panel, consisting of 5 persons experienced in judging pickle quality, rated 8 jars from each treatment. An individual analysis of variance was made for each quality factor. The F value for each of the differences discussed is significant at the 1% level.

A test was conducted to determine whether any difference due to treatment could be observed by consumers. A small consumer panel was given slices of the control sample and the sample held 72 hours at 80° F. in a triangular presentation.

RESULTS

Results of both the "in-the-jar" and internal quality ratings are summarized in Table 1. The observed effect of holding time and temperature on "in-the-jar" quality is illustrated in Figure 1. The quality of fresh whole pickles made from cucumbers held at varying times and temperatures was lower than the quality of the controls. The quality of pickles made from cucumbers held at 80° F. was lower than those held at 40° F. for corresponding time periods; however, the quality of cucumbers held at 40° F. was not reduced when the holding time was increased from 24 to 72 hours. The quality of cucumbers held for 72 hours at 60° F. was lower than the quality of cucumbers held at 60° F. for 24 hours; and the quality of cucumbers held at 80° F. for 48 hours was lower than the quality of cucumbers

TABLE 1
Pickle quality ratings
(Each rating is the mean of 20 observations)

Treatment	"In-the-Jar" quality ratings[1]	Panel quality ratings[2]			
		Acceptability for commercial use	Flavor	Color	Skin texture
No storage	7.6	3.0	2.8	2.9	3.3
1 day, 40°	5.8	2.7	2.2	2.8	3.2
1 day, 60°	5.2	2.6	2.9	2.8	3.2
1 day, 80°	4.3	2.0	2.4	2.2	2.8
2 days, 40°	5.6	2.7	2.8	2.8	3.0
2 days, 60°	4.2	2.2	2.4	2.4	2.6
2 days, 80°	2.4	1.4	2.2	1.8	2.3
3 days, 40°	5.0	2.6	2.8	2.9	2.9
3 days, 60°	3.5	1.7	2.2	2.2	2.4
3 days, 80°	1.3	1.0	1.9	1.2	1.7
L.S.D. .01	1.2	0.45	0.38	0.45	0.38

[1] Rating scale: 1 = very poor; 9 = excellent.
[2] Rating scale: 1 = very poor; 4 = excellent.

[a] Journal Paper No. 1927. Michigan Agricultural Experiment Station, East Lansing, Michigan.

[b] Presented before the Sixteenth Annual Meeting of the Institute of Food Technologists, St. Louis, Missouri, June 12, 1956.

[c] Provided by the Wm. J. Stange Company.

held at 80° F. for 24 hours. Ratings for time-of-holding and temperature-of-holding treatments changed in a linear manner. The quality of the pickles decreased uniformly as the temperature increased and as the time of holding became longer.

Averages of ratings by the experienced panel (Table 1) indicate differences between treatments on the basis of color, skin texture, flavor and acceptability for commercial use. These results are comparable to the ratings for external quality, with

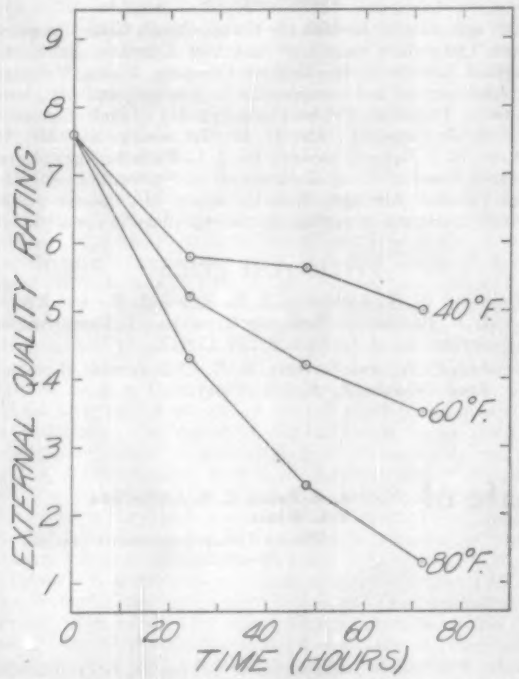

Figure 1. Observed effect of holding time and temperature on "in-the-jar" quality of fresh whole pickles.

the same differences present in both sets of data. It was found in this experiment that the two harvest dates yielded pickles of similar quality.

The consumer panel was not able to establish a difference on the basis of flavor between the control samples of pickles and pickles made from cucumbers held for 72 hours at 80° F.

DISCUSSION

Delay in precessing fresh cucumbers of the variety SR-6 into fresh whole dill pickles had a detrimental effect on quality. Quality factors that were seriously affected by holding cucumbers before packing were skin color and texture, discoloration of spine spots, shrinking at the stem end, and loss of desired flavor. Deterioration of skin color, scuffed and dirty skin areas, and discoloration of spine spots have, in the past, been blamed on rough handling of the fresh cucumbers. Results of this study indicate that this "rough handling" injury may be due to an unfavorable combination of holding time and temperature. Observations of the packing methods of commercial processors indicate that pickles made from cucumbers held for several days at high temperatures before packing are poor in appearance.

There appear to be several practical ways for the processor to avoid or substantially limit quality deterioration due to holding cucumbers too long at too high a temperature before packing. An awareness of the deleterious effect of holding cucumbers, coupled with the scheduling of sequential operations from field to bottling line, is undoubtedly the simplest measure. In a plant where cucumbers are both salted and fresh-packed, the versatility of the salting operation should permit effective scheduling of fresh cucumbers to the bottling line. A 40° F. refrigerated storage may be essential in plants that operate 2 shifts per day for 7 days per week during the cucumber season, if the plant is to operate at top capacity with minimum quality deterioration.

Results of this experiment indicate that it may be possible to predict the processed quality of a lot of cucumbers by knowing the length of time and average temperature at which they have been held. Any of several methods might be used to make this prediction. One of the alternatives to be considered is put forth here and is illustrated in Figure 2. The graph line, developed from data obtained in this experiment, represents an arbitrarily chosen quality rating. It divides the chart into two parts or areas. The area below and to the left of the line includes all holding conditions which will allow pickles of acceptable quality to be produced.

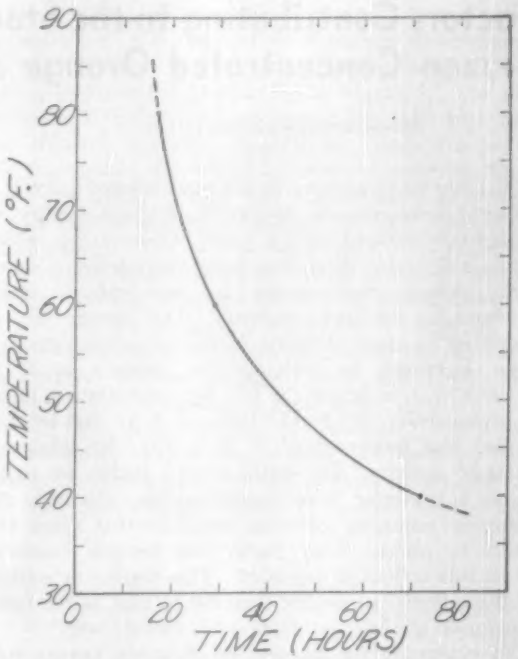

Figure 2. A graphic method of determining the permissible holding times and temperatures to produce pickles of a quality rating of 5.0 (fair).

The area above and to the right of the curve includes the conditions which will not allow pickles of desirable quality to be produced. Thus, the line is an artificial breaking point. To use this method, it would be necessary for the packer to choose a quality standard to be considered as the minimum acceptable level of quality in

the finished product. Then a chart similar to Figure 2 would be constructed to show the holding conditions required to allow production of the desired quality. This proposal is preliminary. There is not sufficient data available to show the effects of season, location, and variety on the response of cucumbers to storage.

SUMMARY

A study was made to determine the effect of holding SR-6 variety cucumbers on the quality of the whole fresh dill pickles. Cucumbers held for 24 hours at 40° F. before packing were rated lower on "in-the-jar" quality than the immediately packed controls. Increasing the holding time and temperatures of the cucumbers resulted in further uniform deterioration of quality. Color and general appearance were most affected, although undesirable changes of flavor were observed in pickles made from cucumbers held for 72 hours at 80° F. before packing. This flavor difference was not detected by a consumer panel.

Quality loss due to holding cucumbers at too high a temperature for too long a time can be minimized by proper scheduling of the packing operation. Packers who must hold cucumbers for several days may have to resort to refrigeration to maintain quality.

A method of predicting pickle quality based on cucumber holding time and temperature is presented. The method is preliminary since effects such as seasons, locations, and varieties have not been fully investigated.

Acknowledgment

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LITERATURE CITED

1. Esselen, W. B., Anderson, E. E., Ruder, L. F., and Pflug, I. J. Pasteurized fresh whole pickles. I. Pasteurization studies. *Food Technol.*, **5**, 279 (1951).
2. Fabian, F. W., and Switzer, R. G. Classification of pickles. *Fruit Products J.*, **20**, 136 (1941).

Factors Contributing to the Storage Life of Frozen Concentrated Orange Juice[a]

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(Manuscript received October 1, 1956)

Cloud or turbidity in the reconstituted juice is a physical characteristic indicative of good quality in frozen concentrated orange juices. Concentrates which retain a desirable cloud after being subjected to a short-term elevated temperature are accepted as stable products by the citrus industry. The storage life, as indicated by cloud stability, of frozen concentrates has been increased by keeping the product at 0° F. (—17.8° C.) or below *(3, 12)*, by concentrating juices to high density, 57° to 75° Brix *(2, 4, 6)*, and by controlled heat treatment *(1, 2, 8, 9, 16)*. By inhibiting enzymic activity, the water-soluble pectin in citrus juices is protected from deesterification. Pectin is the naturally occurring colloidal stabilizer that gives viscosity to juices. They clarify and become "watery" when this colloid is degraded. This results in settling of the colloidal suspended material as well as the rapid separation of water-insoluble solids called "pulp".

In evaluating the storage life of frozen orange concentrates, citrus researchers *(2, 5, 9)* have tried to correlate pectinesterase activity with cloud stability. However, because of the disappointing results of such attempts, McColloch and Rice *(11)* have suggested the differential cloud determination in judging the stability of these products. Kew *(10)* in published information on the 1951-52 Florida commercial packs, demonstrated a marked difference in cloud stability among samples tested when stored at 35° F. (1.7° C.). Recently Rouse, Atkins, and Moore *(14)*, in a study of Florida commercial frozen orange concentrates for the 1954-55 season, found that samples stored at 40° F. (4.4° C.) also varied greatly in cloud stability.

The purpose of the present investigation was to study the role of pectin as a contributing factor to the storage life of frozen concentrated orange juice and to determine whether or not the inherent cloud stability of orange concentrate is due to the quantity of pectin present and to the pectinesterase activity. If the affirmative is true, then a reasonably complete index of product stability could only be obtained by knowing the values of both these factors. This study was undertaken to test the effect of these two factors on the storage life of 42° Brix concentrates at a storage temperature of 40° F.

EXPERIMENTAL PROCEDURE

Preparation of samples. To show the relationship of pectin and pectinesterase to the storage life of 42° Brix orange concentrate, 8 commercial packs were selected having approximately the same pH, 3.8-3.9, and turbidity, whereas the 2 variables studied were the amount of pectin and pectinesterase activity. A group of 4 packs was chosen which contained a low content of pectin and 4 levels of pectinesterase activity; namely, low, average, above average, and high. Another group of 4 packs was picked which contained a high content of pectin and had 4 similar levels of enzymic activity. Pulp content of the

[a] Cooperative research by the Florida Citrus Experiment Station and Florida Citrus Commission. Florida Agricultural Experiment Station Journal Series, No. 328.

former group was lower than that in the latter. The relative values of low and high content of pectin and low, average, above average, and high activity (Table 1) were obtained from the examination of 215 packs of commercial frozen concentrated orange juices produced in Florida during the 1954-55 season.

For each sample, 15 cans with the same code number from one of the selected commercial orange packs were removed from —8° F. (—22.2° C.) storage and thawed for 1 hour on a rotary thawer at 40° F. The thawer is a Thermo-Roto type with rolls submerged in water at 40° F. The speed of rotation of the rolls is 60 r.p.m. Cans of thawed concentrate were immediately mixed into a composite to insure uniformity, rapidly poured into 6-oz. cans, sealed, and placed at 40° F. storage. This procedure prevented the temperature of the product from rising above 40° F. Samples of the 8 concentrates were removed for analysis at periodic intervals until extreme clarification had developed.

Methods of analyses. Pectinesterase activity was determined on the reconstituted juices by the method described by Rouse and Atkins *(13)*. Pectinesterase units are expressed by the symbol (PE.u.)g. which represents the milliequivalents of ester hydrolyzed per minute per gram of soluble solids (° Brix). These are multiplied by 1000 for easy interpretation.

Cloud or turbidity was measured by percentage light transmittance through samples of reconstituted juices *(1)* after centrifuging for 15 minutes at 1700 r.p.m. in an International Centrifuge, Size 1, Type SB. Light transmittance values were obtained using a Photovolt Lumetron 402-E colorimeter with 730 mμ filter and 14 ml. cell set to read 100% transmittance on distilled water. The degree of clarification in orange juice as indicated by ranges of percentage light transmittance was as follows: 0-59% = none; 60-69% = slight; 70-84% = definite; 85-100% = extreme. On this basis, a satisfactory cloud in a citrus juice is one which shows a light transmittance not greater than 69%, whereas unsatisfactory cloud is indicated by transmittance values of 70% or above.

Pectin was determined as anhydrogalacturonic acid (AGA) on a portion of the reconstituted centrifuged juice designated as "serum" upon which light transmittance values were also obtained. The pectic substances in the reconstituted juices were also determined *(13)* on the basis of their solubility in water, ammonium oxalate, and sodium hydroxide. These are expressed as milligrams per 100 g. of juice.

RESULTS AND DISCUSSION

Initial characteristics of the 8 selected commercial samples of 42° Brix orange concentrates are presented in Table 1. Samples 1 through 4 are products with low content of pectin containing from 27.2 to 31.0 mg./100 g. serum, while samples 5 through 8 represent those products with high content of pectin from 44.0 to 53.7 mg./100 g. serum. The 4 levels of pectinesterase activity in each group were alike. Thus, for comparison, samples 1 and 5 have similar low activities, whereas the variation is in the quantity of pectin, 28.5 mg./100 g. in the former and 50.4 mg./100 g. in the latter. Likewise, the pairs of samples such as 2 and 6, 3 and 7, and 4 and 8 are similar except for the quantity of pectin which is low in the first sample and high in the second sample of each pair. Also presented in Table 1 are the pectic substances determined in the reconstituted juices by successive extraction with water, ammonium oxalate, and sodium hydroxide. It is important to note that the quantity of water-soluble pectin in reconstituted juice is about the same as the amount of pectin found in the serum of reconstituted juice of the same sample. The quantity of ammonium oxalate- and sodium hydroxide-soluble pectin is not believed to be a factor in the storage life of orange concentrate, as indicated by cloud stability. However, the importance of such pectic substances may be in that they disperse light if suspended as finely divided particles along with the chromatophores and other cellular material. However, as the concentrates lost their stability during storage, the water-soluble pectin decreased as the oxalate-soluble increased. Huskins and Kew *(7)* have also shown that the water-soluble pectin decreased when concentrates were stored at temperatures above 0° F. and that the rate of decrease followed the order of stability.

The length of time at 40° F. during which a satisfactory cloud was retained in 8 orange concentrates, having various levels of pectinesterase activity and pectin, is presented graphically in Figure 1. The unshaded and shaded bars represent juices with high and low content of pectin, respectively; both groups of juices contained 4 levels of activities. In each of the 4 pairs, the storage life of the concentrates was always greater in the sample containing the high content of pectin; also the duration of satisfactory cloud retention in a stored sample decreased with increased pectinesterase activity, when pectin was the same. Samples 5, 6, 7, and 8, containing a high content of pectin, retained a satisfactory cloud for 50, 12, 14, and 3.5 days, respectively, whereas samples 1, 2, 3, and 4 with low content of pectin retained a good cloud for 10, 4, 3.5, and 1.5 days, respectively. Also samples 5 and 1 had approximately the same low activity, but due to its high content of pectin, sample 5 had a storage life at 40° F. five times greater than sample 1; samples 8 and 4 had

TABLE 1

Initial properties of selected commercial samples of frozen 42° Brix orange concentrates

Sample number	Reconstituted juices							
	Centrifuged juice (serum)		Noncentrifuged juice					
			Pectin as AGA soluble in				(PE.u.) g. soluble solids × 1000	Pulp by volume %
	Light transmittance %	Pectin as AGA mg./100 g.	Water mg./100 g.	Ammonium oxalate mg./100 g.	Sodium hydroxide mg./100 g.	Total mg./100 g.		
1	40	28.5	26.5	14.9	31.0	72.4	4.0	6.5
2	35	31.0	32.3	16.8	37.5	86.6	5.7	7.0
3	40	29.1	29.1	18.8	33.0	80.9	12.5	6.5
4	42	27.2	26.3	20.9	30.4	77.6	18.3	7.0
5	38	50.4	53.0	33.6	61.4	148.0	3.8	12.5
6	34	53.7	57.0	33.0	63.4	153.4	7.6	12.5
7	36	49.8	53.0	29.7	64.0	146.7	11.0	11.5
8	38	44.0	49.2	26.5	45.9	121.6	18.6	10.0

approximately the same high activity, but due to its greater pectic content, sample 8 had a storage life slightly more than twice that of sample 4. In samples with similar quantities of pectin and with activity in a range of 8 to 12 units, the storage life of the product at 40° F. was about the same.

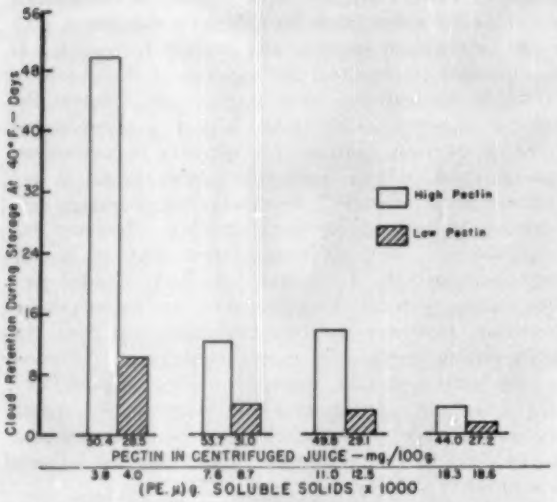

Figure 1. Retention of cloud during storage at 40° F. in 42° Brix commercial orange concentrates with four levels of pectinesterase activity and either low or high pectin content.

The gradual loss during storage at 40° F. of pectin in orange concentrates containing a low quantity of pectin and 3 levels of pectinesterase activity is shown in Figure 2; similarly, the loss of pectin in products having a high pectin content and 3 levels of activity is illustrated in Figure 3. When the amount of pectin is the same, either high or low, the stability (and the rate of loss of pectin) of the product during storage is dependent upon the enzymic activity; the sample with a low activity being more stable than that with a high activity. Since the storage life of the samples with average and above average activities was about the same, the loss of pectin during storage was also similar; therefore, samples with above average activities were not graphically shown in Figures 2 and 3.

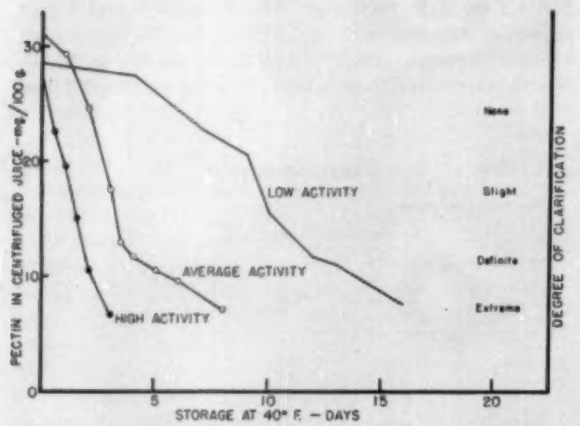

Figure 2. Effect of low pectin content on the storage life at 40° F. of 42° Brix commercial orange concentrates containing three levels of pectinesterase activity.

Degree of clarification as *none, slight, definite,* and *extreme* is indicated on the right side of Figures 2 and 3. Within certain limits a greater quantity of pectin in a sample does not necessarily increase the cloud as shown by light transmittance values in Table 1, but does prolong the retention of cloud. Previous work *(15)* has shown that a pectin concentration of 25 mg./100 g. serum produced a cloud in a juice having approximately the same light transmittance as that in a juice with double that amount of pectin. Furthermore, after extreme clarification had occurred in all of the 8 commercial orange concentrates, the quantities of pectin remaining for samples 1, 2, 3, and 4 were 7.9, 7.1, 6.5, and 6.5 mg./100 g. serum; for samples 5, 6, 7, and 8 the amounts of pectin remaining were 12.3, 11.0, 9.1, and 9.7 mg./100 g. serum. It would seem that the latter group, with the greater amount of pectin remaining in

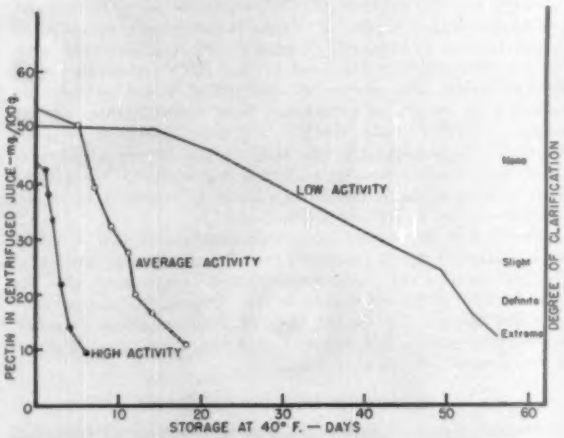

Figure 3. Effect of high pectin content on the storage life at 40° F. of 42° Brix commercial orange concentrates containing three levels of pectinesterase activity.

the sample, should have had slightly more cloud. Since this was not found to be so, another factor other than pectinesterase activity or pectin content is indicated; this factor is the depolymerization of the pectin molecule. Thus, it is possible that the pectin in samples 5, 6, 7, and 8 was more depolymerized than that in samples 1, 2, 3, and 4. This relationship of depolymerization of pectin to cloud retention has not been too well investigated, but could well be an influencing factor in the storage life of orange concentrates with different stabilities where pectin quantity and enzymic activity are the same.

It was also noted that a high content of water-soluble pectin in the orange concentrates was associated with high pulp content. Pulp, as determined by the centrifugal method, increased during storage at 40° F. as the water-soluble pectin decreased resulting in the formation of insoluble pectates and pectinates; light transmittance values also increased.

It was also observed that as loss of cloud occurred,

the color bodies or chromatophores, were almost completely absent in the serum by the time definite clarification had taken place, as indicated by a light transmittance reading of 70% or above. Cataphoretic experiments were determined on the water-soluble pectin and the fine suspended particles which disperse light in orange serum. Pectin was found to carry an electrically negative charge, which is normal, and the cellular white suspended particles also had a negative charge. However, the chromatophores exhibited a positive charge. Since like charges on colloid particles repel each other and opposite charges on particles attract or adhere, the inference is that this causes the suspension to coagulate and settle out. More information is needed concerning both the identification of the suspended particles which disperse light in the centrifuged juice and the effect of particle charge on cloud mechanism.

SUMMARY

A 42° Brix orange concentrate containing 50 mg. of pectin per 100 g. of serum retained a satisfactory cloud for 50 days when stored at 40° F., whereas a concentrate with 29 mg. of pectin per 100 g. of serum remained stable for only 10 days; pectinesterase activity in each product was about 4 units. Samples with either high or low quantity of pectin but both with approximately 18.5 units of activity retained satisfactory clouds for 3.5 and 1.5 days, respectively. Therefore, when pectinesterase was the same, a sample of orange concentrate containing a high content of pectin had a longer storage life than that with a low content of pectin. Storage life of a product, in which the content of pectin was alike, depended upon the enzymic activity; a product with high activity was less stable than one with low activity. Water-soluble pectin decreased with loss of cloud during storage of the concentrate at 40° F.

Other factors concerning cloud mechanism, such as depolymerization of pectin and electrical charges on suspended and dispersed particles in orange juice serum, are briefly discussed. Water-soluble pectin and the finely divided white suspended materials were found to carry negative charges, while chromatophores had positive charges. The chromatophores were completely flocculated when definite clarification occurred.

Acknowledgments

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LITERATURE CITED

1. Atkins, C. D., Rouse, A. H., Huggart, R. L., Moore, E. L., and Wenzel, F. W. Gelation and clarification in concentrated citrus juices. III. Effect of heat treatment of Valencia orange and Duncan grapefruit juices prior to concentration. *Food Technol.*, **7**, 62 (1953).
2. Bissett, O. W., Veldhuis, M. K., and Rushing, N. B. Effect of heat treatment temperature on the storage life of Valencia orange concentrates. *Food Technol.*, **7**, 258 (1953).
3. DuBois, C. W., and Kew, T. J. Storage temperature effects on frozen citrus concentrates. *Refrig. Eng.*, **59**, 772 (1951).
4. DuBois, C. W., and Murdock, D. I. The effect of concentration on quality of frozen orange juice with particular reference to 58.5° and 42° Brix products. I. Chemical and physiological aspects. *Food Technol.*, **9**, 60 (1955).
5. Guyer, R. B., Miller, W. M., Bissett, O. W., and Veldhuis, M. K. Stability of frozen concentrated orange juice. I. The effect of heat treatment on enzyme inactivation and cloud stability of frozen concentrate made from Pineapple and Valencia oranges. *Food Technol.*, **10**, 10 (1956).
6. Huggart, R. L. Effect of concentration on clarification in concentrated citrus juices. *Proc. Florida State Hort. Soc.*, **65**, 237 (1952).
7. Huskins, C. W., and Kew, T. J. Notes on factors associated with gelation in frozen concentrated orange juice. *Proc. Florida State Hort. Soc.*, **66**, 254 (1953).
8. Joslyn, M. A., and Sedky, A. Effect of heating on the clearing of citrus juices. *Food Research*, **5**, 223 (1940).
9. Keller, G. J., Rice, R. G., McColloch, R. J., and Beavens, E. A. Stabilization of frozen citrus concentrates by heat treatment. *Food Technol.*, **8**, 195 (1954).
10. Kew, T. J. Changes in commercial frozen orange concentrates stored at several temperatures. *Proc. Florida State Hort. Soc.*, **68**, 167 (1955).
11. McColloch, R. J., and Rice, R. G. Properties of stored frozen orange concentrate observed by differential cloud determination. *Food Technol.*, **9**, 70 (1955).
12. Moore, E. L., Huggart, R. L., and Hill, E. C. Storage changes in frozen concentrated citrus juices—preliminary report. *Proc. Florida State Hort. Soc.*, **63**, 165 (1950).
13. Rouse, A. H., and Atkins, C. D. Pectinesterase and pectin in commercial citrus juices as determined by methods used at the Citrus Experiment Station. Florida Agr. Exp. Sta. *Tech. Bull. 570* (1955).
14. Rouse, A. H., Atkins, C. D., and Moore, E. L. Relationship of heat treatment to the quality of processed citrus products. III. Physical and chemical changes in frozen concentrated citrus juices when thawed and stored at 40° F. Univ. Florida Agr. Exp. Sta. (Unpublished Progress Report, June, 1955).
15. Rouse, A. H., Atkins, C. D., Moore, E. L., and Olsen, R. W. Chemical and physical qualities of commercial samples of frozen concentrated orange juices. Univ. Florida Citrus Exp. Sta. *Mimeo. Rept.* 55-6, October 12 (1954).
16. Stevens, J. W., Pritchett, D. E., and Baier, W. E. Control of enzymatic flocculation of cloud in citrus juices. *Food Technol.*, **4**, 469 (1950).

Color of Capsicum Spices. III. A Linear Color Scale[a]

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IN THE FIRST TWO PAPERS of this series *(3, 4)* the lack of standardization of procedures for determining the extractable color of capsium spices was pointed out and methods were presented for preparing extracts of these spices and for measuring the color of the extracts. The present publication continues with the over-all problem and is concerned with the units employed to designate color of capsicum spices.

At the present time, a number of different color scales are in use. This has caused considerable confusion, since, in the majority of cases, the scales are not linear. For example, a color value of 20 does not represent twice the tinctorial power of a value of 10.

Of the number of color scales employed only a few have been described in technical journals. The most common of these, the Lovibond red scale (standardized with a Lovibond 20-yellow) was first introduced by Lowenstein and Dunne *(2)*, and later referred to by Moster and Prater *(3, 4, 6)*. The latter have developed a scale composed of Gentry units *(3)* which are readily convertible to the better known Lovibond red units. Neither of these scales is linear.

While the present publication was being prepared, Shuster and Lockhart *(7)* reported some preliminary studies on a capsicum color method. These authors suggested that a linear color scale be developed based on a single spectrophotometric or filter-photometric reading of an acetone extract of capsicum spice. In one respect this technique is similar to the potassium dichromate-cobaltous chloride method[b] *(1)*, as both are restricted to measuring only the contribution of the carotenoids to the extractable color of capsicum spices, whereas the Lovibond method considers the chlorophyll-like pigments *(3)* as well.

In the present publication, both the carotenoid and chlorophyll-like pigments are taken into consideration. A practical linear scale is introduced and its limitations under the various conditions encountered in the commercial use of capsicum spcies are pointed out.

METHODS AND MATERIALS

The Gentry method *(3)* was employed for measuring the extractable color of capsicum spices. Samples were extracted for 3 hours at 70° ± 1° C. using 99% isopropanol as the solvent *(4)*. Oleoresin color values were determined by the oleoresin spectrophotometric method *(5)*. The oleoresins were prepared in the laboratory from ground capsicums by Soxhlet extraction with petroleum ether (b.p. 60-71° C.).

[a] Presented in part at the Fourteenth Annual Meeting of the Institute of Food Technologists, Los Angeles, Calif., July 1, 1954.

[b] The potassium dichromate-cobaltous chloride method *(1)*, discussed in some detail in the fourth publication of this series *(5)*, is used extensively to measure the color of oleoresins of capsicum spices. However, sometimes the method is modified and applied directly to dry capsicum spices, although this is not a common procedure.

RESULTS AND DISCUSSION

In the first paper of this series *(3)* an abridged spectrophotometric procedure, the Gentry method, was developed to replace directly the subjective Lovibond technique. In order to correlate the results obtainable with these two methods it was necessary to consider two groups of pigments, the carotenoids and the chlorophyll-like pigments. It was not possible to obtain good agreement when only the carotenoids were measured. Shuster and Lockhart *(7)* encountered similar results in their development of a photoelectric capsicum color method. In the extracts used in their method the concentration of green chlorophyll-like pigments was too low to be detected. Good correlation was not obtained with the Lovibond method when a 5¼-inch tube, which is standard procedure for the latter, was used. However, when a 2-inch tube was employed the correlation was excellent. It should be noted that the role of the chlorophyll-like pigments is much less pronounced with a 2-inch tube than with a 5¼-inch tube. Shuster and Lockhart concluded that by not considering the chlorophyll-like pigments their method had a distinct advantage over the Lovibond technique. With only the carotenoids to measure, their results could be expressed readily in units which have a linear relationship to each other. Neither Lovibond nor Gentry units are linear.

It is the purpose of this investigation to develop a linear color scale composed of units which reflect the concentration of both the carotenoid and chlorophyll-like pigments. It is felt that any abridged photoelectric procedure designed to replace the widely-used Lovibond method should take into account all of the pigments contributing to the color measured in the latter method. This would include the green chlorophyll-like pigments. In addition the authors have found the measurement of these green pigments to be a helpful tool in the general evaluation of ground capsicum spices. The presence of excess amounts indicates that either green immature pods were used in processing or that added stems are present. This applies to all types of capsicum spices except chili powder[c] where the chlorophyll-like pigment content depends to a large extent on the amount of added spices, such as oregano and cumin. As indicated in Table 1 each type of capsicum spice has a characteristic range of chlorophyll-like pigment content. Any deviations from this normal range indicates an abnormality in the raw material used in processing.

The most obvious approach to the development of a linear color scale is to prepare a series of capsicum extracts using different but known amounts of the

[c] The use of the terms "chili powder" and "chili pepper" is sometimes confusing. According to common usage, chili powder is a blend of ground capsicum and other spices. Ground capsicum alone is referred to as "chili pepper."

TABLE 1
T_{650} values of capsicum spices

Capsicum spice	Number of samples	Range of T_{650} values[1]	Average T_{650} values
Paprika (prepared from stemmed pods)	11	94.2-98.2	96.6
Paprika (prepared from whole pods)	22	87.7-92.8	90.7
Chili pepper (prepared from whole pods)	23	83.7-88.8	86.9
Chili powder (prepared from whole pods)	15	75.0-84.6	80.9

[1] The term "T_{650} value" is employed in the Gentry method *(3)* and is a measurement (transmittancy at 663 mμ) of chlorophyll-like pigment concentration. The lower the T_{650} value the higher the concentration and vice versa.

same sample. This procedure has been applied to three types of capsicum spices and the resuts are given in Figure 1. It should be noted in this figure that the three spices have the same color value at lower concentrations but are noticeably different at higher concentrations. This is caused by quantitative differences in their chlorophyll-like pigment content. These differences increase as relatively greater amounts of sample are extracted. Since the green chlorophyll-like pigments detract from the red color of the carotenoids, comparatively lower color values result in samples containing greater amounts of these green pigments. It is obvious from Figure 1 that the linear relationship between different points on any one of the three curves is not the same for corresponding points on either of the other two.

Figure 1 illustrates a system in which the concentration of both the chlorophyll-like and the carotenoid pigments change as color changes. This is generally not the case in the practical usage of capsicum spices where the amount of spice employed is usually fixed by flavor rather than color considerations. Different color levels are generally obtained not by varying the amount of spice but rather by employing different grades. Under these circumstances the carotenoid content is changed but the chlorophyll-like pigments remain approximately the same. This situation would apply to chili powder, chili pepper, cayenne and red pepper. A major exception would be paprika which is used primarily for its color, its flavor generally being quite mild and not detectable over a wide range of concentration. With paprika, color changes can be effected by varying either the amount or grade.

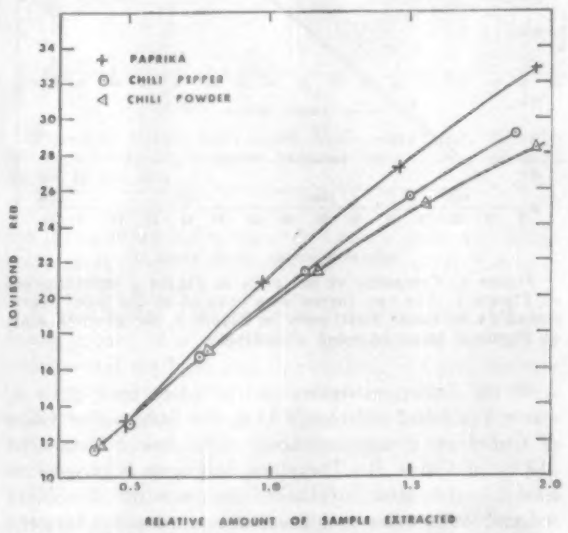

Figure 1. The difference in "color value versus quantity of sample extracted" between 3 capsicum spices containing different proportions of chlorophyll-like pigments. The sources of the latter in the 3 samples were: paprika (made from stemmed pods)—none; chili pepper (made from whole pods)—stems; chili powder (made from whole pods)—stems and added spices (cumin and oregano).

Figure 2 illustrates a system which reflects the practical usage of most capsicum spices. Here the carotenoid content is varied while the chlorophyll-like pigments remain constant. As pointed out, this system will not apply for all cases of paprika. The error involved is illustrated later in the discussion.

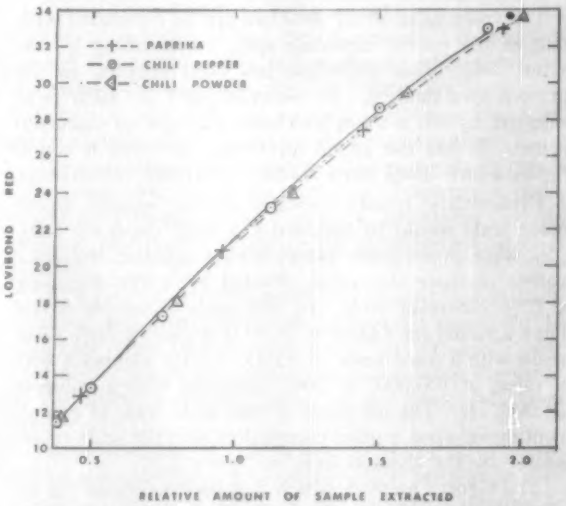

Figure 2. Color value versus relative amount of sample extracted in a system where the carotenoid content varies while the chlorophyll-like pigments remain constant. The extracts used are the same as those employed in Figure 1, except constant theoretical rather than varying experimental T_{650} values were employed to calculate Lovibond red. For all paprika extracts — T_{650} = 96.6; chili pepper extracts — T_{650} = 86.9; chili powder extracts — T_{650} = 80.9. These values were taken from Table 1.

The selection of the range of units for the capsicum linear color scale was made with the following factors taken into consideration: (a) the units should not be readily confused with existing color units; (b) they should be simple to use and readily understood; and (c) if possible they should be related to the units employed in measuring color of oleoresins of capsicum spices. At present, Lovibond red (most widely used scale in the industry) is unrelated to oleoresin color units.

It is often necessary to know quality, colorwise, of the oleoresin obtainable from a ground capsicum sample. This is particularly important to manufacturers of oleoresins because the value of their products will depend upon the amount of color present in the parent raw materials. It would therefore be of considerable convenience if the results of a simple routine color analysis of a ground capsicum sample would indicate

the color value of the oleoresin which could be prepared from that sample.

Although oleoresin color methods *(1, 5)* can be used directly on ground capsicum spices and the results expressed on a one-gram-of-ground-spice basis, in normal usage, these methods are employed only for the color evaluation of oleoresins. This necessitates preparation of the oleoresin from the ground spice prior to analysis, and because the yield of oleoresin is not the same for all samples, it is impossible to establish a general fixed relationship between color value of an oleoresin and that of the parent ground spice. For example, if oleoresins are prepared from two capsicum samples of equal color value and if sample A yielded 10% oleoresin with a color value of 40,000 and sample B yielded 5% oleoresin, then the color value of the latter should theoretically be 80,000.

The color value of an oleoresin can be correlated with that of the parent capsicum spice by assuming a constant yield. This technique has been adopted in the present investigation. An assumed yield of "10%" was selected, as this is an approximate average for capsicum spices. It has the added advantage of being a round figure which lends itself readily to further calculations.

Preliminary results indicated that a suitable linear color scale would be obtained if ground capsicum samples were given color values which equalled the color values of their oleoresins, divided by 1,000, assuming a 10% oleoresin yield. In this scale a sample would have a value, for example, of 50 if it yielded 10% oleoresin with a color value of 50,000, or 5% oleoresin with a value of 100,000, or 20% oleoresin with a value of 25,000, etc. The adoption of this scale was, of course, contingent upon a good correlation with the scale represented by the abscissa axis in Figure 2.

The Gentry method, which was used to obtain the results shown in Figure 2, considers the role of both the carotenoid and the chlorophyll-like pigments in measuring the color of capsicum spices. On the other hand, the spectrophotometric oleoresin color method *(5)* takes into account the carotenoids only. Thus, in order to obtain a satisfactory correlation between these two methods, only samples containing no significant amount of chlorophyll-like pigments were used. The relationship between ground capsicum color value and oleoresin color value as defined in the preceding paragraph therefore applies theoretically to this type of capsicum spice only. This has not proved to be a serious drawback because an approximately correlation between these values will be indicated for other types of capsicum spices and this is certainly preferable to no correlation at all. In addition, when closer correlations are desired, they can be arrived at readily by substituting "96.6" (see Table 1) for the T_{443} value actually obtained.

Lovibond color values of a number of samples containing no significant amounts of chlorophyll-like pigments were determined. Oleoresins were prepared from these samples and their color values were also determined. The latter were divided by 10,000 and multiplied by the percent oleoresin yield to obtain the corresponding linear color units.

In Figure 3, Lovibond red units are plotted against linear color units. The similarity of the shape of this plot to those illustrated in Figure 2 was established by superimposing a composite of the latter on the former, as shown in Figure 4. The two plots were equated at the point represented by 40 linear color units or 40,000 oleoresin color units (assuming a 10% yield) because the latter is typical of an average good quality commercial oleoresin.

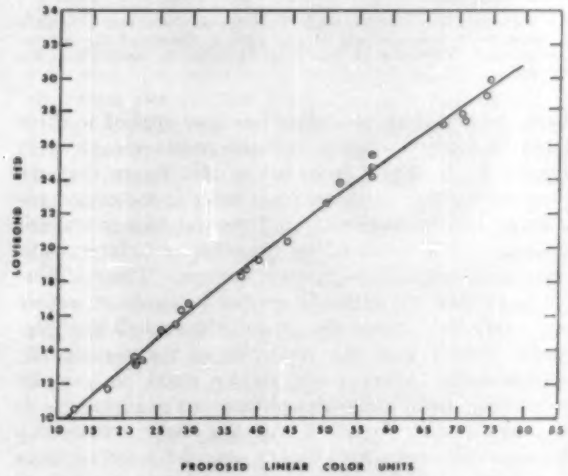

Figure 3. Lovibond red units versus proposed linear color units.

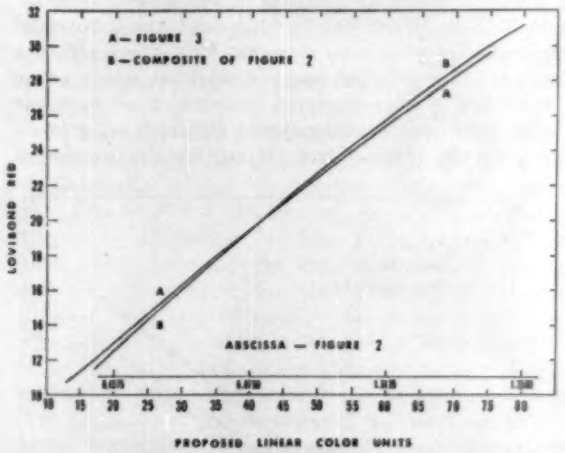

Figure 4. Composite of the plots in Figure 2 superimposed on Figure 3. The two curves were equated at the point represented by 40 linear color units in Figure 3, the abscissa scale of Figure 2 being adjusted accordingly.

At the lower extremity of the plots in Figure 4, where Lovibond red equals 11.4, the linear color value of Curve A is approximately 10% lower than that (17.1) of Curve B. Therefore, if Curve B is used to establish the final correlation between the Lovibond red and linear color unit scales, the relationship between oleoresin color units and linear color units as shown in Figures 3 and 4 will be in error to the extent of 10% at the 17.1 linear color unit level. This is not a serious drawback to this relationship, particularly when it is realized that capsicum samples with this low a color

value are rarely considered suitable for the manufacture of oleoresins. At higher color values, the difference is considerably less. For example, at the level where Lovibond red equals 29.6, the difference is only 2%.

The Gentry method was originally developed using 95% ethanol *(3)*. Since that time it has been recommended that 99% isopropanol be used instead *(4)*. In order to avoid the inconvenience and possible confusion involved in specifying the nature of the solvent each time a color value is reported, it is recommended that the Lovibond scale be reserved for values determined with 95% ethanol while the linear color scale be reserved for determinations made with 99% isopropanol. This procedure has been adopted in the authors' laboratories.

The final correlation between Lovibond red and linear color units was established using Curve B in Figure 4. The Gentry method *(3)* determines color in terms of Gentry units which are then converted to Lovibond red by means of a table or graph. Figure 5 shows

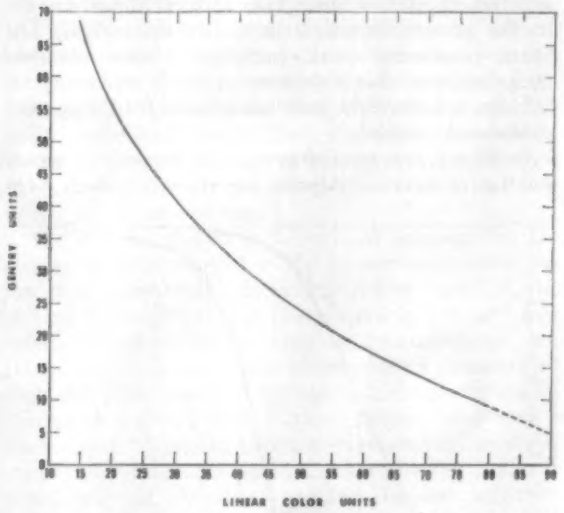

Figure 5. Gentry units versus linear color units. The plot has been extrapolated beyond 80 linear color units as indicated by the broken line.

the direct relationship between Gentry units and linear color units. For convenience this relationship has been compiled in a table.[d]

It was stated previously in the discussion that the linear nature of a color scale composed of one set of units would not hold true in reflecting the practical use of all capsicum spices, particularly paprika. To illustrate the possible extent of error which the newly developed scale is subject to in such cases, the following experiment was carried out.

Different amounts of a relatively low grade of paprika (prepared from pods containing a normal complement of stems) were extracted in the usual manner with 99% isopropanol. The linear color units were determined and the results are shown in Table 2.

Taking the lowest value as the starting point, it is seen that the highest value is 10.4% lower than theoretically expected. It is felt that the extent of this error does not render the use of scale prohibitive, partciularly since the illustration in Table 2 represents an extreme rather than a typical example.

[d] Available upon request from the authors.

TABLE 2

Extent of error in the linear color scale when applied to paprika prepared from whole capsicum pods (containing stems)

Grams of sample	Linear color units		Percent deviation from theoretical
	Experimental	Theoretical	
0.1	23.3	23.3	.....
0.2	46.1	46.6	1.1
0.3	65.7	69.9	6.0
0.4	83.5	93.2	10.4

SUMMARY

A linear color scale offering improvements over the Lovibond red system has been developed. In addition to the carotenoids, the latter system also measures the chlorophyll-like pigments, and therefore their contribution to the color of capsicum extracts has been given consideration in the present investigation.

The sources of the chlorophyll-like pigments in capsicum spices are: the green pericarps of immature pods, the stems normally present in pods, and spices such as oregano and cumin added in the manufacture of chili powder.

Since two color components are present in capsicum extracts, a 2-unit color scale should be employed to designate their color. However, for practical convenience, a 1-unit scale, designed to minimize the error in the linear interrelationship of its units, has been devised.

The new scale is simple to use. In addition to designating the color of a ground capsicum sample, it also estimates the color value of the oleoresin obtainable from that sample. The latter is arrived at by assuming a 10% yield of oleoresin and multiplying the linear color value obtained by 1,000.

Acknowledgments

The authors wish to express their appreciation to Mrs. Susan Peters, Mrs. Elsebeth S. Andersen and Mr. Jack Stubblefield for their assistance in this investigation.

LITERATURE CITED

1. Guenther, Ernest. *The Essential Oils*, Volume 1, 1948, p. 330. D Van Nostrand Company, Inc., New York, N. Y.
2. Lowenstein, Arthur, and Dunne, W. P. Spanish paprika. *J. Ind. Eng. Chem.*, 2, 139 (1910).
3. Moster, J. B., and Prater, A. N. Color of capsicum spices. I. Measurement of extractable color. *Food Technol.*, 6, 459 (1952).
4. Moster, J. B., and Prater, A. N. Color of capsicum spices. II. Extraction of color. *Food Technol.*, 11, 146 (1957).
5. Moster, J. B., and Prater, A. N. Color of capsicum spices. IV. Oleoresins paprika. *Food Technol.*, 11, 226 (1957).
6. Moster, J. B., and Prater, A. N. Color measurement in other products. *Color in Foods—A Symposium*, p. 129. Quartermaster Food and Container Institute for the Armed Forces, Chicago, Illinois. November (1953).
7. Shuster, Herbert V., and Lockhart, Ernest E. Development and application of objective methods for quality evaluation of spices. I. Color-grading of capsicums. *Food Research*, 19, 472 (1954).

Color of Capsicum Spices. IV. Oleoresins Paprika

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OLEORESINS PREPARED FROM CAPSICUM SPICES have achieved a wide popularity among food processors. Those produced from hot varieties of capsicums are called oleoresins capsicum [a] and are employed commercially for their concentrated pungent flavor. Those prepared from mild varieties are called oleoresins pakrika and are characterized by the readiness with which they impart their color and subtle flavor to other food products. The intensity of color of oleoresins paprika is very important in establishing their value. Thus, it is necessary to have available analytical methods by which this color can be measured conveniently and accurately.

The most common method currently employed is carried out by matching a dilute acetone solution of oleoresin with an inorganic salt standard composed of potassium dichromate and cobaltous chloride in water *(1)*. A human observer is used in this procedure and consequently the method is vulnerable to the usual errors associated with subjective techniques. In addition, the conditions under which the method is carried out may vary considerably. Sometimes dilutions are made on a 1-ml. basis rather than the usual 1-g. basis. The scale length of the Nessler tubes employed may differ markedly. Use of a standard light source has not been established, and it is the authors' understanding that some but not all laboratories use opaque jackets around the Nessler tube.

In the present article a spectrophotometric method for measuring the color value of oleoresins paprika is presented. This method differs from the potassium dichromate-cobaltous chloride method mainly in the substitution of an objective procedure for the subjective human observer. Lest too great a change might curtail the adoption of a new technique, the fundamental principles of the older method have not been varied, even though evidence is presented which indicates that this method may not adequately reflect the performance of oleoresins paprika in commercial practice.

While the present paper was being prepared, Shuster and Lockhart *(6)* reported preliminary results on an objective method for measuring the color value of oleoresins of the genus *Capsicum*. In these studies absorbancy of acetone solutions of oleoresins measured with a photoelectric instrument were correlated with color values determined by the potassium dichromate-cobaltous chloride method. In this respect, these studies were similar, although more limited in scope, than those carried out in the present investigation.

PRINCIPLE OF METHOD

The potassium dichromate-cobaltous chloride method *(1)* calls for the use of 50-ml. Nessler tubes and states that the height of the liquid in the tube should be about 8 inches (20.3 cm.). The 50-ml. Nessler tube calibrated closest to this height is the so-called "tall form." According to the manufacturer *(5)* the scale of these tubes can run from 20.0 to 25.0 cm. but they can be supplied in sets with a 0.15-cm. tolerance. Prior to this investigation, a survey of several laboratories revealed that scale lengths from 12.6 to 30.8 cm. were in use. In one laboratory "short form" Nessler tubes (12.6 cm.) were being employed and another reported the use of 100-ml. tubes (30.8 cm.). In the present investigation, theoretical considerations concerning the potassium dichromate-cobaltous chloride method are based on a scale length of 20.3 cm. as specified in the method *(1)*.

A 20.3-cm. light path is not convenient to employ with a spectrophotometer because it requires the construction of special absorption cells, cell holders, etc. In the present investigation a Beckman Model DU Spectrophotometer was employed. Since standard equipment with this instrument is the 1-cm. absorption cell, etc., a 1-cm. light path was selected for the spectrophotometric method.

In Figure 1, spectral transmission curves of a typical solution of oleoresin paprika are shown for both 1-cm. and 20.3-cm. light paths. It is obvious that these two curves differ considerably from each other. It is also obvious that spectral transmission curves of two solutions may be similar for one length of light path but markedly different for another. This is seen by comparing the corresponding curves of the standard with those of the oleoresin.[b]

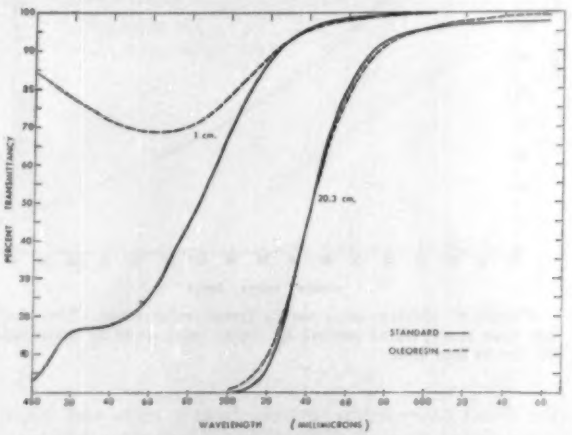

Figure 1. Spectral transmittancy of an oleoresin paprika in acetone and the potassium dichromate-cobaltous chloride standard (1) for 1-cm. and 20.3-cm. light paths.

[a] Some confusion exists in the terminology of oleoresins prepared from capsicum spices. The term "oleoresin capsicum" is used sometimes to designate all oleoresins prepared from pods of the genus *Capsicum*. However, the most common usage of this term (employed in the present publication) is reserved for those oleoresins prepared from hot peppers only.

[b] Figure 1 explains an interesting phenomenon which often puzzles technicians employing the potassium dichromate-cobaltous chloride method; namely, why the standard appears much darker than the sample if viewed through the diameter (approximately 1.6 cm.) of the Nessler tubes, even though a perfect match has been established by observation through the height of the tubes.

These differences illustrate the fallacy of assuming that absorbancy of an oleoresin dilution determined with a 1-cm. cell at a single wavelength can be used to estimate the color value of the oleoresin as determined by a human observer using a 20.3-cm. column. Before the former procedure can be adopted, proof of a constant relationship between the values obtainable with these two techniques must be established. This proof is necessary not only because of the differences illustrated in Figure 1, but also because it is possible to have two solutions with exactly the same color [metameric colors *(3)*] but with different spectral transmission or absorption curves. In such cases their absorbancies determined at only one wavelength may be markedly different from each other. It will be shown later in this paper that color values obtained by the newly-proposed spectrophotometric method using a 1-cm. sample cell do correlate well with values obtained with the potassium dichromate-cobaltous chloride method and therefore that the conversion from the former to the latter is not subject to the possible sources of error cited above.

Since absorbancy is expressed in quantitative units and since we are attempting to correlate it with color it would be preferable to define color in quantitative terms. A convenient way to do this is by the method of the International Commission on Illumination employing trichromatic coefficients[c] *(2)*. The theory involved in the use of these units is given in some detail in the first publication of this series *(4)* and hence is discussed only briefly at the present time.

The samples studied in the present investigation are similar to those studied in the earlier investigation in that they transmitted only insignificant amounts, if any, of blue light. The z (or blue) coefficient in all cases equalled approximately zero when calculated for Illuminant C. Under these circumstances chromaticity could be fully described by either trichromatic coefficients x or y since $x + y + z = 1$ becomes $x + y = 1$ when $z = 0$. Thus, we have a convenient 1-dimensional scale which can be compared directly with the 1-dimensional scale of absorbancy values obtained with the spectrophotometric method.

METHODS AND MATERIALS

Data for calculating trichromatic coefficient y values were determined on 19 samples of oleoresins paprika and on 4 separately prepared potassium dichromate-cobaltous chloride standards using the Thirty Selected Ordinate method for Illuminant C *(2)*. Transmittancies were determined at all wavelengths specified by the method, using the Beckman Model DU Spectrophotometer, equipped with 10-cm. sample cells. The values obtained were then used to calculate corresponding transmittancies for the light path lengths under consideration using Bouguer's law. The spectrophotometer was calibrated and operated in the same manner described in the first article of this series *(4)*.

Both commercially- and laboratory-prepared oleoresins were examined. They were selected so as to include the different types of interest to the capsicum spice industry.

All dilutions in the potassium dichromate-cobaltous chloride method were prepared on a 1-g. basis and the terminology employed in reference to these dilutions was the same as that referred by Guenther *(1)*. For example, "1.00 g. of oleoresin made up to 100 ml. with acetone" is referred to as a 1% solution. This is actually an incorrect designation because the specific gravity of oleoresins of capsicum spices is different than that of acetone. However, because of its widespread use, no correction of this mode of designation was attempted. Matched Nessler tubes[d] (50-ml. "tall form") were employed and daylight was used as the light source.

DEVELOPMENT OF METHOD

In the potassium dichromate-cobaltous chloride method *(1)* color value equals:

$$100\ \frac{50-(0.02)\ (\text{no. of ml. of } 0.02\% \text{ solution required})}{(0.02)\ (\text{no. of ml. of } 0.02\% \text{ solution required})} \qquad (1)$$

A more convenient equation which gives approximately the same result as Equation 1 is:

$$100\ \frac{50}{(0.02)\ (\text{no. of ml. of } 0.02\% \text{ solution required})} = \frac{250{,}000}{\text{no. of ml. of } 0.02\% \text{ solution required}} \qquad (2)$$

Equation 2 gives results which are only 0.1% to 1% (for color values of 100,000 to 10,000 respectively) lower than those obtained with Equation 1, and for convenience has been used exclusively in the present investigation.

A wavelength of 470 mμ was chosen for use with the spectrophotometric method. At this point the spectral absorption curves of acetone solutions of oleoresins paprika are relatively flat. It was found that a 0.006% concentration was convenient for use with a 1-cm. absorption cell at this wavelength and that within the range of absorption values obtained with this combination there is no significant deviation from Beer's Law. This is illustrated in Table 1.

TABLE 1

Absorbancies (470 mμ., 1-cm. absorption cell) of multiple acetone dilutions of a typical oleoresin paprika

Relative concentration	Absorbancy		% deviation from theoretical[1]
	Experimental	Theoretical	
1	0.077	0.077	0
2	0.154	0.154	----
5	0.396	0.385	+2.9
10	0.789	0.770	+2.5

[1] Based on Relative Concentration 2.

In the potassium dichromate-cobaltous chloride method, a 0.006% solution is obtained when 15 ml. of 0.02% solution is diluted to 50 ml. Substituting (15 ml.) in Equation 2, a color value of 16,667 is obtained. Therefore, color value by the spectrophotometric method equals:

$$\frac{\text{absorbancy (sample)} \times 16{,}667}{\text{absorbancy (oleoresin dilution which matches the standard)}} \qquad (3)$$

The first attempt to determine the value of the denominator in Equation 3 was unsuccessful. In this attempt 65 individual color determinations were made on 13 different samples using 3 observers. After a sample had been matched with the potassium dichromate-cobaltous chloride standard its absorbancy was measured at 470 mμ, employing a 1-cm. absorption cell. The range of absorbancies obtained was quite large (0.108-0.169) and the average changed considerably from one set of determinations to the other, indictaing that the 3 observers were failing not only to match each other's results, but also to duplicate their own results from one period of time to the next. This technique was therefore abandoned in favor of the following.

[c] Actually trichromatic coefficients define only two attributes of color—hue and saturation (together known as chromaticity). The third attribute, brightness, is defined by the term "tristimulus Y." The potassium dichromate-cobaltous chloride method does not specify whether chromaticity or brightness should take precedence. In the authors' opinion, based on several years of experience, it is the chromaticity of the standard which is matched. When such a match has been effected, the difference in brightness is usually not great.

[d] The Nessler tubes available for this investigation had an average scale length of 24.0 cm.

Trichromatic coefficient y and tristimulus Y were determined for a number of oleoresins diluted with acetone to approximately match the potassium dichromate-cobaltous chloride standard. At the same time their absorbancies were measured at 470 mμ using a 1-cm. sample cell. Visual inspection of the results showed absorbancy to be better correlated with y than with Y. In Figure 2, y for a 20.3-cm. light path is plotted against absorbancy.

Trichromatic coefficent y and tristimulus Y values, determined on 4 separately-prepared potassium dichromate-cobaltous chloride standards, are presented in Table 2. The average y value was 0.4637. Theoretically, an acetone solution of oleoresin having this same y value would be a match in chromaticity to the standard. In Figure 2 it is seen that such a solution when measured at 470 mμ, using a 1-cm. absorption cell, would have an absorbancy of 0.157.

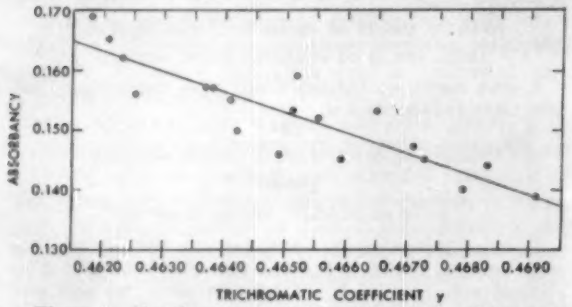

Figure 2. Absorbancy at 470 mμ. (1-cm. light path) versus trichromatic coefficient y (20.3-cm. light path) of acetone dilutions of oleoresin paprika.

TABLE 2

Trichromatic coefficient y and tristimulus Y values (20.3-cm. light path) of the potassium dichromate-cobaltous chloride standard

Standard sample[1]	y	Y
A	0.4638	59.76
	0.4635	59.03
B	0.4639	59.86
	0.4637	59.11
Average	0.4637	59.44

[1] Standard sample A was prepared from potassium dichromate and cobaltous chloride stock solutions 2½ months old, B—from stock solutions 10 months old.

In Figure 2 the point farthest away from the line of best fit represents a deviation from that line of less than 5%. It therefore seems reasonable to conclude that within the limits of this deviation, and for the degree of dilution concerned (0.006%) absorbancy determined at 470 mμ with a 1-cm. absorption cell can be used to estimate the chromaticity of an acetone solution of oleoresin paprika as viewed by the standard observer through a 20.3-cm. light path using daylight* as a light source.

By substituting the value 0.157 in Equation 3, color value by the spectrophotometric method equals:

$$\frac{\text{absorbancy (sample)} \times 16{,}667}{0.157} \quad (4)$$

$$= \text{absorbancy (sample)} \times 106{,}159 \quad (5)$$

In addition to examining oleoresins paprika, several samples of oleoresins capsicums (see footnote *a*) were studied. The correlation between absorbancy and trichromatic coefficient y was not good for these samples and, consequently, the spectrophotometric method has been limited to use with oleoresins paprika only. This is not a serious drawback to the method because the color of oleoresins capsicum is many cases is of minor interest, the important quality factor being pungency. The lack of correlation between y and absorbancy for oleoresins capsicum is believed to be due to qualitative pigment differences in the various types of small-fruited very pungent capsicums from which these oleoresins are prepared.

* Illuminant C approximates average daylight *(2)*.

TABLE 3

Comparison of methods for measuring the color of oleoresin paprika

Sample	Determination	Spectrophotometric method		Potassium dichromate-cobaltous chloride method	
		technician		technician	
		N	M	N	M
A	1.	72,600	72,600	76,900	76,900
		72,800	71,700	78,200	76,900
	2.	71,900	71,300	89,300	79,400
		72,100	73,200	79,400	76,900
	3.	71,800	72,600	79,400	74,600
		71,700	72,100	79,400	73,500
	4.	71,100	70,900	74,600	75,700
		71,500	72,400	80,600	68,500
	Average	71,900	72,100	79,700	75,300
	Range	70,900 – 73,200		68,500 – 89,300	
B	1.	39,700	39,900	45,800	42,400
		39,500	40,200	43,500	40,300
	2.	41,800	41,100	48,100	41,000
		41,000	40,800	47,200	40,000
	3.	41,200	41,500	45,800	44,600
		42,200	42,700	43,800	44,300
	4.	42,100	42,200	45,800	44,300
		42,300	41,300	50,000	41,000
	Average	41,200	41,200	46,300	42,200
	Range	39,500 – 42,700		40,000 – 50,000	

RESULTS AND DISCUSSION

The comparative accuracy of the two methods employed in the present investigation is illustrated in Table 3. It can be seen that more consistent values were obtained with the spectrophotometric method. It should be stressed that this experiment was carried out in a single laboratory in which a rigid standard procedure was employed with the potassium dichromate-cobaltous chloride method. It is expected that even greater variations would be encountered with this method in commercial practice.

SPECTROPHOTOMETRIC METHOD

Scope. The method measures the color value of oleoresins paprika but is not applicable to oleoresins capsicum. It is designed to replace the potassium dichromate-cobaltous chloride method but expresses results in the same oleoresin color units.

Apparatus. A Beckman Model DU Spectrophotometer equipped with 1-cm. sample cells.

Procedure. 1. Prepare a 0.006% (see Methods and Materials) solution of oleoresin paprika in acetone. This can be conveniently done as follows: Prepare a 1% solution; dilute 2 ml. of this to 100 ml.; dilute 15 ml. of the latter to 50 ml.

2. Using a 1-cm. absorption cell, determine absorbancy at 470 mμ.

3. Oleoresin color units = absorbancy x 106,159 (for convenience use 106,000).

4. If a color value greater than 75,000 is obtained, then repeat procedure using a 0.003% solution in Step 1 and multiply the color value obtained by the factor "2".

SUMMARY

A method has been developed for measuring the color value of oleoresins paprika. This method involves the

TECHNICAL PROGRAM AND ABSTRACTS

Seventeenth Annual Meeting

of the

Institute of Food Technologists

May 12 through May 16, 1957

Pittsburgh, Pennsylvania

GENERAL AND SOCIAL EVENTS

SATURDAY, MAY 11, 1957

Executive Committee Meeting
10:00 a.m. Suite 566-68-70
Penn-Sheraton Hotel

Pittsburgh Section Committee Chairmen Dinner Meeting
6:00 p.m. Suite 566-68-70
Penn-Sheraton Hotel

Editorial Board Meeting
7:30 p.m. Room 735
Penn-Sheraton Hotel

SUNDAY, MAY 12, 1957

National Council Meeting
10:00 a.m. Monongahela Room
Penn-Sheraton Hotel

Registration
10:00 a.m. 17th Floor
Penn-Sheraton Hotel

Exhibits—Official Opening
1:00 p.m. 17th Floor
Penn-Sheraton Hotel

Ladies Get-Acquainted Punch Bowl
3:00 p.m. Pittsburgh Room
Penn-Sheraton Hotel

Press Conference
4:00 p.m. Parlor C
17th Floor
Penn-Sheraton Hotel

Social Hour
8:00 p.m. Ballroom
Penn-Sheraton Hotel

MONDAY, MAY 13, 1957

Section Officers' Breakfast
7:30 a.m. Club Room
Penn-Sheraton Hotel

Registration
8:00 a.m. 17th Floor
Penn-Sheraton Hotel

General Opening Session
9:00 a.m. Ballroom
Penn-Sheraton Hotel

Ladies' Tour Golden Triangle Day
10:00 a.m.

Awards Luncheon
12:15 p.m. Pittsburgh Room
Penn-Sheraton Hotel

Technical Program
2:00 p.m. Ballroom
Monongahela Room
Pittsburgh Room
2:40 p.m. Terrace Room

Gourmet's Delight
5:30 p.m. Departure from Penn-Sheraton Hotel
6:00 p.m. Syria Mosque

TUESDAY, MAY 14, 1957

M. I. T. Alumni Breakfast
7:30 a.m. Club Room
Penn-Sheraton Hotel

Canadian Group I. F. T. Breakfast
7:30 a.m. Suite 468-70
Penn-Sheraton Hotel

Wisconsin Group Breakfast
7:30 a.m. Aero Room
Penn-Sheraton Hotel

Registration
8:00 a.m. 17th Floor
Penn-Sheraton Hotel

Technical Program
9:00 a.m. Four Sessions
Terrace Room
Ballroom
Monongahela Room
Pittsburgh Room
Penn-Sheraton Hotel

Ladies' Tour Civic Center
10:00 a.m. Mellon Institute, Heinz Chapel
Cathedral of Learning

University of Massachusetts Alumni Luncheon
12:15 p.m. Aero Room
Penn-Sheraton Hotel

University of Illinois Alumni Luncheon
12:15 p.m. Suite 468-70
Penn-Sheraton Hotel

Ohio State University Alumni Luncheon
12:15 p.m. Grant Room
Penn-Sheraton Hotel

General Session
2:00 p.m. Babcock-Hart Award Address
Ballroom
Penn-Sheraton Hotel

Technical Program
3:00 p.m. Four Sessions
Ballroom
Monongahela Room
Terrace Room
Pittsburgh Room
Penn-Sheraton Hotel

Movie
"Treasure Chest"
5:10 p.m. Monongahela Room
Penn-Sheraton Hotel

Appert Award Banquet
6:30 p.m. Ballroom
Penn-Sheraton Hotel

WEDNESDAY, MAY 15, 1957

Committee on Education Breakfast
7:30 a.m. Club Room
Penn-Sheraton Hotel

Registration
8:00 a.m. 17th Floor
Penn-Sheraton Hotel

Technical Program
9:00 a.m. Four Sessions
Ballroom
Monongahela Room
Pittsburgh Room
Terrace Room

Ladies' Tour
9:00 a.m. H. J. Heinz Company Breakfast
Becks Charter Oaks
Carriage House

Installation Luncheon
12:15 p.m. Monongahela Room
Penn-Sheraton Hotel

General Session Appert Award Address
2:00 p.m. Ballroom
Penn-Sheraton Hotel

Technical Program
3:00 p.m. Four Sessions
Ballroom
Monongahela Room
Terrace Room
Pittsburgh Room

Phi Tau Sigma Honorary Society Meeting
5:00 p.m. Terrace Room
Penn-Sheraton Hotel

THURSDAY, MAY 16, 1957

Registration
8:00 a.m. 17th Floor
Penn-Sheraton Hotel

University of California Breakfast
7:30 a.m. Monongahela Room
Penn-Sheraton Hotel

Symposium—Methodology of Sensory Testing
9:00 a.m. Ballroom
Penn-Sheraton Hotel

Symposium—Methodology of Sensory Testing
2:00 p.m. Ballroom
Penn-Sheraton Hotel

Plant Tours
8:30 a.m. to 1:00 p.m. Aluminum Company of America
New Kensington Works
New Kensington, Pa.

8:30 a.m. to 12:00 m. Jones & Laughlin Steel Corp.
Aliquippa Works
Aliquippa, Pa.

9:00 a.m. to 12:45 p.m. U. S. Steel Corporation
Allied Research Laboratory
Monroeville, Pa.

1:30 p.m. to 4:00 p.m. Mellon Institute and
Duquesne Brewery
Pittsburgh, Pa.

1:30 p.m. H. J. Heinz Company
Pittsburgh, Pa.

LADIES' ENTERTAINMENT PROGRAM

The Pittsburgh Ladies' Entertainment Committee extends a hearty welcome to all the visiting ladies. A program has been designed to introduce you to the Pittsburgh Renaissance, to give you free time for shopping and a variety of features for all.

Sunday, 3:00 P.M.

Be sure to join us around the punch bowl in the Pittsburgh Room at the Penn-Sheraton Hotel. You are also invited to the social hour in the evening, open to all registrants.

Monday, 10:00 A.M.

Golden Triangle Day starts with breakfast at Kaufmann's Department Store featuring "Mrs. Consumer Wants to Know," time to shop, and later a chance to see the new downtown Pittsburgh.

Tuesday, 10:00 A.M.

A day in our Civic Center starts at Mellon Institute with luncheon at the Faculty Club and an opportunity to see the Heinz Chapel and the famed Nationality Rooms at the Cathedral of Learning.

Wednesday, 9:00 A.M.

The Heinz Company has invited us to breakfast and for a tour of their plant. Sightseeing buses will continue from Heinz to Beck's Charter Oaks Carriage House, where luncheon will be served. Displays of furniture and decorating ideas will interest all, and, of course, you might shop there, too. Back to the hotel by 3:00 p.m.

A ladies' lounge has been provided as a central meeting place, where information about the city will be available and messages can be exchanged. All buses or cabs will leave from the Grant Street entrance of the hotel. In order to assure good service and adequate transportation, tickets will have to be purchased in advance; and, we're sorry, but we cannot make cancellations.

I. F. T. TOURS

Thursday, May 16—Plant Tours

Pittsburgh offers many diversified industries allied with the food field. Of the many industries, a group has been selected which will give a cross-section of the major industries in the Pittsburgh area.

Research Basic to Industry. Research plays a very important role in this area. It is to be shown in two separate tours, The United States Steel Applied Research Laboratory and the Mellon Institute of Industrial Research.

Steel Making. The major industry in the Pittsburgh area will be shown by the Jones & Laughlin Steel Corporation.

Metal Fabricating. Another important industry in this area will be shown by Alcoa.

Food Preparation. This industry is to be shown by the H. J. Heinz Company.

Brewing. This industry will be shown by the Duquesne Brewing Company.

Aluminum Company of America

New Kensington, Pennsylvania

The buses for this tour will leave at 8:30 a.m. and return at 1:00 p.m. The buses will leave from the Grant Street Entrance of the Penn-Sheraton Hotel and go along the beautiful Allegheny River on Route 28.

The Aluminum Company of America, New Kensington Works, is the parent plant. During your visit to Alcoa, it is planned for you to visit the fabricating divisions; the remelt, extrusion, tube, foil, jobbing, cooking utensil manufacturing and central machine areas of the mechanical division.

Since aluminum is becoming increasingly important to the Food Technologist, this tour should be of prime interest to you.

Jones and Laughlin Steel Corporation

Aliquippa, Pennsylvania

This tour will start at 8:30 a.m. and end at 12 noon. Buses will leave the Penn-Sheraton Hotel (Grant Street Entrance) and go to Aliquippa via the Ohio River Boulevard. From this highway one may

see much of the diversified industries of the Pittsburgh area. At Aliquippa one may have the opportunity to visit an integrated steel plant where raw materials are processed into steel and a wide variety of steel products.

The Aliquippa Works covers 480 acres, extending for about 4 miles along the Ohio River.

Since a complete walk through the giant plant would require days, it has been arranged for the buses to transport you to points of interest within the works.

The areas to be shown will be the open hearth furnaces, the blooming mill and the tin mill. Plans are for you to spend most of your time observing the manufacture of tin plate.

The Aliquippa Works is responsible for production of J & L's full line of tin mill products consisting of electrolytic tin plate, hot dipped tin plate and black plate. The continuous electrolytic tinning line moves at fantastic speeds. An X-Ray gauge for quality control is in this completely modern operation.

United States Steel Corporation
Applied Research Laboratory

Monroeville, Pennsylvania

This tour will start at 9:00 a.m. and end at 12:45 p.m. Buses to the U. S. Steel Laboratory will leave the Penn-Sheraton Hotel (Grant Street Entrance) at 9:00 a.m. They will travel east on the new Penn-Lincoln Parkway to the U. S. Steel Research Center in the rural setting at Monroeville.

At this research center the facilities are divided between two main groups, the Edgar C. Bain Laboratory for fundamental research and the Applied Research Laboratory.

The Applied Research Laboratory contains administrative offices, bench scale laboratory, library, experimental engineering shop and the raw materials processing building. A major portion of the Applied Research Laboratory is of a one-story construction to accommodate large equipment and pilot-line facilities.

The Fundamental Research Laboratory is a two-story building containing small laboratories, offices, library and auditorium.

Of special interest to the Institute of Food Technologists is the research work on container-metal quality with special emphasis on tin plate and black plate. The research on sheet metal with emphasis on enameling, galvanizing and stainless steel production should be intriguing to the Food Technologists.

At the United States Steel Research Center will be found the most modern facilities for development of steel materials for shipment and storage of food products. Visitors will be guided through the buildings with pre-arranged stops at the laboratories of special interest to the Institute of Food Technologists. Visitors must be American citizens and will not be allowed to carry cameras.

H. J. Heinz Company
Food Preparation

Pittsburgh, Pennsylvania

This tour will leave the Penn-Sheraton Hotel (Grant Street Entrance) at 1:30 p.m. and return at 4:00 p.m.

Visitors will be shown successive steps in the processing of a wide variety of food products. Gleaming kitchens and rapid-fire filling lines, can factory and materials handling equipment of the latest design are viewed at close range. The new Finished Goods Warehouse, final destination of overhead conveyor lines that run through all buildings, will afford an intimate view of modern completely automatic mass handling of merchandise. Other points of interest include the ultra-modern Vinegar Building and the nation's most complete research and quality control center, now nearing completion.

Scheduled to run an hour and a half, the Heinz plant tour terminates at its point of origin. It is concluded with a showing of a historical and informational film entitled, "The Big Kitchen," and with a tasty buffet-style snack which features five Heinz varieties.

As a memento of their sojourn at Heinz, all visitors are given the famed Heinz pickle pin, an item to "go over big" with the young folks back home.

Mellon Institute of Industrial Research
and
Duquesne Brewing Company of Pittsburgh

This combination tour will depart from the Penn-Sheraton Hotel (Grant Street Entrance) at 1:30 p.m. and return at 5:00 p.m.

The Mellon Institute of Industrial Research is the first organization of its kind; it is an endowed nonprofit institution and allied cooperatively with the University of Pittsburgh. The investigational activities of the Institute have been largely in the fields of chemistry, physics, engineering and technology, with ever-increasing emphasis on their application to the important problems of human welfare. Thus public health, sanitation, foods, stream-pollution control, smoke abatement, the alleviation of industrial hazards, and improvements in a great number of processes and products which will ultimately benefit all of us are the projects in which Mellon Institute's scientists are engaged.

Many fellowships here are of interest to the Institute of Food Technologists. Two of these are supported by the H. J. Heinz Company which has sustained a Multiple Fellowship that has pioneered in many sectors of basic food technology, and the Bread Fellowship which has been devoting attention to improving the quality of salt-rising bread and simplifying its production. The Multiple Fellowship on Chemical Hygiene, supported by Union Carbide and Carbon Corporation, has been devoting the major part of its activity to studying the safety of chemical residues remaining in food as the result of new developments in production, processing and packaging fields. The Multiple Fellowship on Bone Products, supported by the Baugh & Sons Company, is well known for its contributions in the field of solid synthetic adsorbents, including "Synthad," widely used in sugar refining. The Multiple Fellowship on Protective Coatings is maintained by Stoner-Mudge, Inc.

Duquesne Brewing Company of Pittsburgh

The guided tour of the Duquesne Brewing Company will consist of inspecting (a) the very modern Brew Building where grains are stored, (b) process cooking of grains and finally (c) the brewing of beer. All grain movements to and from storage are controlled from a single point—the electric panel or the Electric Brain.

The tour will then continue to the very modern and new bottling department where the very latest in machinery is in use, including the bottle inspector, the "Electric Eye."

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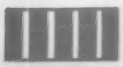

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THE TECHNICAL PROGRAM

IN SUMMARY

Monday, May 13

9:00 A.M. General Session—Ballroom
2:00 P.M. Section A—*Waste Disposal*—Ballroom
2:00 P.M. Section B—*Meat*—Pittsburgher Room
2:00 P.M. Section C—*Enzymes*—Monongahela Room
2:40 P.M. Section D—*Fermentation*—Terrace Room

Tuesday, May 14

9:00 A.M. Section E—*General*—Terrace Room
9:00 A.M. Section F—*Poultry*—Monongahela Room
9:00 A.M. Section G—*Radiation*—Ballroom
9:00 A.M. Section H—*Fruits and Vegetables*—Pittsburgher Room
2:00 P.M. General Session—Ballroom
Babcock-Hart Award Address
3:00 P.M. Section I—*Bacteriology*—Monongahela Room
3:00 P.M. Section J—*Industry and Education*—Ballroom
3:00 P.M. Section K—*General*—Terrace Room
3:00 P.M. Section L—*Frozen Foods*—Pittsburgher Room

Wednesday, May 15

9:00 A.M. Section M—*Fruits and Vegetables*—Terrace Room
9:00 A.M. Section N—*Antibiotics*—Ballroom
9:00 A.M. Section O—*Dehydration*—Monongahela Room
9:00 A.M. Section P—*Objective Quality Measurements*—Pittsburgher Room
2:00 P.M. General Session—Ballroom
Appert Award Address
3:00 P.M. Section Q—*Statistical Quality Control*—Monongahela Room
3:00 P.M. Section R—*General*—Terrace Room
3:00 P.M. Section S—*Chemicals in Foods*—Ballroom
3:00 P.M. Section T—*Frozen Foods*—Pittsburgher Room

Thursday, May 16

9:00 A.M. Symposium—*Methodology of Sensory Testing*—Ballroom
2:00 P.M. Symposium (Cont'd)—Ballroom

IN DETAIL

MONDAY MORNING — MAY 13

General Session

Ballroom

9:00— Call to Order

9:05— Welcome to Pittsburgh
C. R. STUMBO, Chairman, Pittsburgh Section

9:15— Announcements
I. J. HUTCHINGS, General Chairman

9:25— Presidential Address
GEORGE F. GARNATZ

10:00— Planning for Tomorrow
L. B. SMITH, President, Thorofare Markets, Inc.

10:30— Roads and You Tomorrow
W. S. LAMPE, Editor, Pittsburgh *Sun-Telegraph*

MONDAY AFTERNOON — MAY 13

Section A—Ballroom

Waste Disposal

Chairman: C. F. WOODWARD

2:00— **1.** U. S. Public Health Service Activities Concerning Industrial Wastes
L. F. WARRICK, Public Health Service, Dept. of Health, Education and Welfare, Washington 25, D. C.

2:20— **2.** The Role of State Sanitary Commissions in Waste Control
F. B. MILLIGAN, Pennsylvania Dept. of Health, Harrisburg, Pa.

2:40— **3.** The Program of the National Canners Association on Waste Disposal
R. A. CANHAM, National Canners Association, Washington 6, D. C.

3:00— **4.** Problems in Handling Poultry Wastes
A. JOEL KAPLOVSKY, Delaware Water Pollution Commission, Dover, Dela.

3:20— **5.** Application of Laboratory Studies to Practical Dairy Waste Disposal
NANDOR PORGES, Eastern Utilization Research Branch, USDA, Philadelphia 18, Pa.

3:40— **6.** Problems in Brandy Stillage in a Municipal Waste Treatment Plant
REESE H. VAUGHN, GEORGE K. YORK II, MELVIN F. KLEMMICK, and L. DOUGLAS DAVIS, Dept. of Food Technology, University of California, Davis, California; Sonoma County Sanitary District, Sonoma; Sabastianni Winery, Sonoma, Cal.

4:00— **7.** Accelerating the Protein Cycle in Nature: Food from Municipal Wastes
ROBERT V. MORSE, Robert V. Morse, Research Laboratory, 521 Wyckoff Road, Ithaca, New York

MONDAY AFTERNOON — MAY 13

Section B—Pittsburgher Room

Meat

Chairman: H. L. A. TARR

2:00— **8.** Hematin Compound Catalyzed Oxidative Fat Rancidity
V. P. MAIER and A. L. TAPPEL, Dept. of Food Technology, University of California, Davis, Cal.

2:20— **9.** Reflectance Spectral Studies of Meat Pigments
A. L. TAPPEL and V. P. MAIER, Dept. of Food Technology, University of California, Davis, Cal.

2:40— **10.** Pigment Changes in Packaged Beef During Storage
PAUL C. PIRKO and JOHN C. AYRES, Dairy and Food Technology Dept., Iowa State College, Ames, Iowa

3:00— **11.** Container Problems Associated with the Addition of Phosphates to the Curing Ingredients of Pork Products
B. J. McKERNAN, R. B. DAVIS, J. F. FOX, O. C. JOHNSON, Continental Can Co., Inc., 1350 W. 76th St., Chicago 20, Ill.

3:20— **12.** Relationships Between Polyphosphates and Salt Impurities in Ham Curing
OVE MADSEN, GEORGE D. WILSON, C. EDITH WEIR, American Meat Institute Foundation, 939 East 57th St., Chicago 37, Ill.

3:40— **13.** Effect of Certain Phosphates on the Water Holding Capacity of Meat
KAISRI POSHYACHINDA and F. E. DEATHERAGE, Ohio Agricultural Experiment Station and The Ohio State University, Dept. of Agricultural Biochemistry, The Ohio State University, Columbus 10, Ohio

4:00— **14.** The Effect of Various Additives on the Stability of Cured Meat
A. M. MULLINS, G. G. KELLEY and D. E. BRADY, University of Missouri, Animal Husbandry Dept., Columbia, Mo.

4:20— **15.** Shrinkage and Organoleptic Characteristics of Beef Aged in Controlled Environments
R. B. SLEETH, G. G. KELLEY and D. E. BRADY, Food Processing Laboratories, Missouri Ag. Experiment Station, Columbia, Mo.

MONDAY AFTERNOON — MAY 13

Section C—Monongahela Room

Enzymes

Chairman: E. F. JANSEN

2:00— **16.** The Effectiveness of Commercial Papain in Meat Tenderization
SHIRLEY WEINER, MARGARET MANGEL, LETA MAHARG and G. G. KELLEY, University of Missouri, Home Economics, Columbia, Mo.

2:20— **17.** Pinking of Onions During Dehydration
THOMAS M. LUKES, Gentry Division, Consolidated Foods Corp., P. O. Box 37, Gilroy, Cal.

2:40— 18. Glucose Oxidase in the Protection of Foods and Beverages

R. R. BARTON, S. S. RENNERT and L. A. UNDERKOFLER, Takamine Laboratory Division Miles Laboratories, Inc., Clifton, N. J.

3:00—19. The Glucose Oxidase-Catalase System as an Oxygen Scavenger for Hermetically Sealed Containers

GEORGE W. KURTZ and YUMIO YONEZAWA, Quartermaster Food and Container Institute for the Armed Forces, 1819 W. Pershing Road, Chicago 9, Ill.

3:20— 20. A Method of Enhancing Flavor Enzyme Systems

S. DAVID BAILEY, U. S. Army Quarter-Master Research & Development Command, QM R & D Center, Natick, Mass.

3:40— 21. Application of Peroxidase Test Paper in Food Processing

HERMAN J. MORRIS, Western Utilization Research Branch, Agricultural Research Service, U. S. D. A., Albany 10, Cal.

4:00— 22. Application of Gas Chromatography to Studies of Off-Flavors Developed During Frozen Storage of Enzyme Systems

PAUL A. BUCK, Dept. of Dairy and Food Inds., University of Wisconsin, Madison 6, Wis.

MONDAY AFTERNOON — MAY 13

Section D—Terrace Room

Fermentation

Chairman: R. N. COSTILOW

2:40— 23. The Effect of Sorbic Acid on Film-Forming Yeasts and Molds in Different Concentrations of Salt in Cucumber Brine Stock

A. H. JONES and T. W. HUMPHREYS, Bacteriology Division, Science Service, Dept. of Agriculture, Ottawa, Canada

3:00— 24. Sorbic Acid as a Selective Agent in Cucumber Fermentations. III. Evaluation of Salt Stock from Sorbic Acid Treated Cucumber Fermentations

RALPH N. COSTILOW, Dept of Microbiology and Public Health, Michigan State University, East Lansing, Mich.

3:20— 25. Vitamin K_5 as a Preservative for Wine

J. N. CASPAR and H. Y. YANG, Food Technology Dept., Oregon State College, Corvallis, Oregon

3:40— 26. The Absorption of Salt by Cucumbers

CARL S. PEDERSON and MARGARET N. ALBURY, New York State Agricultural Experiment Station, Cornell University, Geneva, New York

4:00— 27. Softness in Salt-Stock Pickles

RAUNO A. LAMPI, W. B. ESSELEN, EDWARD E. ANDERSON, and CECIL L. THOMSON, University of Massachusetts, Amherst, Massachusetts

4:20— 28. Preparation of Canned Carbonated Cider from Dessert Varieties

F. E. ATKINSON and J. F. BOWEN, Fruit and Vegetable Processing Laboratory, Experimental Farm, Canada Dept. of Agriculture, Summerland, B. C.

TUESDAY MORNING — MAY 14

Section E—Terrace Room

General

Chairman: E. E. ANDERSON

9:00— 29. Some Newer Chemical Views of Coffee

FREDERICK R. GREENBAUM, Kwik Kafe Coffee Processors of America, Inc., 300 Jacksonville Road, Hatboro, Pennsylvania

9:20— 30. Storage Properties of Vacuum-Packed Coffee

M. C. MERRITT, B. A. CAWLEY, E. E. LOCKHART, B. E. PROCTOR and C. L. TUCKER, Dept. of Food Technology, Massachusetts Institute of Technology, Cambridge, Mass.

9:40— 31. The Chemical Evaluation of the Pungency of Onion and Garlic by the Content of Volatile Reducing Substances

LIONEL FARBER, The George Williams Hooper Foundation, University of California, San Francisco 22, Cal.

10:00— 32. Effect of Different Sugars on the Viscosity and Gel Strength of Starch Pastes

MAURA L. BEAN and ELIZABETH M. OSMAN, Michigan State University, East Lansing, Michigan

10:20— 33. Detection of Drosophila Eggs and Larvae in Tomato Products

J. R. GEISMAN and W. A. GOULD, Ohio Agricultural Experiment Station and The Ohio State University, Columbus, Ohio

10:40— 34. Effect of Low Moisture Levels on the Thermostability of Active Dry Yeast

J. H. MITCHELL, JR. and J. J. ENRIGHT, Quartermaster Food & Container Institute for the Armed Forces, U. S. Army Quartermaster Research & Development Command, 1819 West Pershing Road, Chicago 9, Ill.

11:00— 35. Lindane Residue Changes During Fermentation and Processing of Pickles

MELVIN R. JOHNSTON, Food Processing Laboratories, Missouri Agricultural Experiment Station, Dept. of Horticulture, University of Missouri, Columbia, Mo.

TUESDAY MORNING — MAY 14

Section F—Monongahela Room

Poultry

Chairman: K. G. WECKEL

9:00— 36. The Penetration and Growth of *Ps. Fluorescens* in Chicken Eggs

G. J. MOUNTNEY and W. C. VAN DER ZANT, Texas A. and M. College System, College Station, Texas

9:20— 37. The Use of the Automatic Green Rot Detector to Improve the Quality of Liquid Egg

ARTHUR J. MERCURI, JAMES E. THOMSON, JAMES D. ROWAN and KARL H. NORRIS, Biological Sciences Branch, AMS, USDA, Beltsville, Maryland

9:40— 38. Studies on the Effect of a Chlortetracycline Treatment on Green Rot Spoilage of Eggs

L. E. ELLIOTT and G. L. ROMOSER, Animal & Poultry Husbandry Research Branch, Poultry Products Section, U.S.D.A., and Poultry Dept., University of Maryland, College Park, Maryland

10:00— **39.** Studies on Microbiological Methods for Predicting Shelf Life of Dressed Poultry

W. L. MALLMANN, LAWRENCE DAWSON, BARNET SULTZER and HERBERT WRIGHT, Michigan State University, East Lansing, Michigan

10:20— **40.** Correlation Between Flavor and Number of Microorganisms During Storage of Fresh, Cut-Up Broilers

AGNES FRANCES CARLIN, B. ELIZABETH HOLL and HOMER W. WALKER, Depts. of Home Economics Research and Dairy and Food Technology, Iowa State College, Ames, Iowa

10:40— **41.** The Effect of Sex, Age and Hormonization on Chemical Composition of Chicken Meat

W. W. MARION, K. N. MAY and W. J. STADELMAN, Purdue University, Lafayette, Indiana

11:00— **42.** The Organoleptic Evaluation of Broilers Fed Milk Product Supplements

A. B. HABIGHURST, R. S. MARVIN and S. M. WEISBERG, Research Laboratories Division of National Dairy Products Corporation, Oakdale, Long Island, N.Y.

11:20— **43.** Two Methods for Palatability Evaluation of Chickens Fed Various Experimental Diets

L. M. POTTER, D. CARLSON, L. D. MATTERSON, and E. P. SINGSEN, Dept. of Poultry Science, Storrs Agricultural Experiment Station, University of Connecticut, Storrs, G. L. GILPIN, R. A. REDSTROM, and E. H. DAWSON, Human Nutrition Research Branch, Agricultural Research Service, U. S. D. A., Washington, D. C.

TUESDAY MORNING — MAY 14

Section G—Ballroom

Radiation

Chairman: S. A. GOLDBLITH

9:00— **44.** Experimental Microwave Energy Procedures in Food Preservation

DAVID A. COPSON and ROBERT V DECAREAU, Food Laboratories, Research Division, Raytheon Mfg. Co., Waltham, Mass.

9:20— **45.** The Effect of Combined Heat and Radiation Treatments on Bacterial Spores

B. KAN, S. A. GOLDBLITH and B. E. PROCTOR, Department of Food Technology, Massachusetts Institute of Technology, Cambridge 39, Mass.

9:40— **46.** The Effect of Gamma Radiation on Bacterial Spores which have Undergone Accelerated Germination Induced by Treatment with L-Amino Acids

B. KAN, S. A. GOLDBLITH and B. E. PROCTOR, Department of Food Technology, Massachusetts Institute of Technology, Cambridge 39, Mass.

10:00— **47.** Use of High-Voltage Cathode Rays to Destroy Bacteria of the Salmonella Group in Whole Egg Solids, Egg Yolk Solids, and Frozen Egg Yolk.

R. C. BROGLE, J. T. R. NICKERSON, B. E. PROCTOR and H. LINEWEAVER, Massachusetts Institute of Technology, Cambridge 39, Mass., and Western Utilization Research Branch, U. S. Department of Agriculture, Albany 10, Calif.

10:20— **48.** Ultraviolet Irradiation of Egg White: Salmonella Destruction and Functional Property Effects

OLIVIA A. HAMMERLE, Western Utilization Research Branch, Agricultural Research Service, U. S. Department of Agriculture, 800 Buchanan Street, Albany 10, Calif.

10:40— **49.** Radiation Sterilization of Apple Slices

R. A. GILLIES, A. I. NELSON, M. P. STEINBERG, R. T. MILNER and B. MORGAN, Dept. of Food Technology, University of Illinois, Urbana, Ill.

11:00— **50.** The Level of Irradiation at Which Taste Change is Noted in Bread Made From Irradiated Flour and Irradiated Wheat as Deduced from Taste Panel Results

R. NICHOLAS, D. POLAND, M. A. FRANG, D. E. WIANT, I. J. PFLUG, E. JONES, Dept. of Agricultural Engineering, Dept. of Foods and Nutrition, Michigan State Univ., East Lansing, Mich.

11:20— **51.** Effect of Ionizing Radiations on Southern Oysters

ELIZABETH ANN GARDNER and BETTY M. WATTS, Dept. of Food and Nutrition, Florida State University, Tallahassee, Fla.

TUESDAY MORNING — MAY 14

Section H—Pittsburgher Room

Fruits and Vegetables

Chairman: A. KRAMER

9:00— **52.** Studies on Cherry Scald. I. Relationship Between Bruising and Respiration in Water

ROBERT L. POLLACK, C. RICCIUTI, C. F. WOODWARD and C. H. HILLS, Eastern Utilization Research Service, U.S.D.A., Philadelphia 18, Pa.

9:20— **53.** Studies on Cherry Scald. II. Relationship Between Bruising and Respiration in Air

ROBERT L. POLLACK, R. T. WHITTENBERGER and C. H. HILLS, Eastern Utilization Research Branch, Agricultural Research Service, U.S.D.A., Philadelphia 18, Pa.

9:40— **54.** Causes of Scald in Red Tart Cherries

ROBERT L. LABELLE, JAMES C. MOYER, DAVID B. HAND, WILLARD B. ROBINSON, Dept. of Food Science and Technology, New York State Agricultural Experiment Station, College of Agriculture, Cornell University, Geneva, N.Y.

10:00— **55.** Consumer Preference Studies on Apple Sauce: Sugar-Acid Relations

E. C. DRYDEN and C. H. HILLS, Eastern Utilization Research Branch, Agricultural Research Service, U.S.D.A., Philadelphia 18, Pa.

10:20— **56.** Factors Influencing Drained Weight of Canned Cling Peaches

S. J. LEONARD, B. S. LUH and E. M. MRAK, University of California, Dept. of Food Technology, Davis, Cal.

10:40— **57.** Penetration of Maltosaccharides in Processed Clingstone Peaches

R. E. HUGHES JR., C. O. CHICHESTER and CLARENCE STERLING, University of California, Dept. of Food Technology, Davis, Cal.

11:00— 58. Relation of Acidity to Variation in Browning of Canned Grapefruit Sections During Storage

R. L. HUGGART, F. W. WENZEL and E. L. MOORE, Florida Citrus Commission, and Florida Citrus Experiment Station, Lake Alfred, Florida

TUESDAY AFTERNOON — MAY 14

Ballroom

General Session

2:00— BABCOCK-HART AWARD ADDRESS

TUESDAY AFTERNOON — MAY 14

Section I—Monongahela Room

Bacteriology

Chairman: W. B. ESSELEN

3:00— 59. Rapid Estimation of the Bacterial Content of Precooked Frozen Foods

ROBERT P. STRAKA and J. L. STOKES, Western Utilization Research Branch, Agricultural Research Service, U.S.D.A., Albany 10, Cal.

3:20— 60. A Survey of the Bacteriological Quality of Frozen Poultry Pies as Obtained on a Local Retail Market

ERCOLE CANALE-PAROLA and Z. JOHN ORDAL, Dept. of Food Technology, University of Illinois, Urbana, Ill.

3:40— 61. Preservation of Apple Cider with Sodium Sorbate

E. A. WEAVER, J. F. ROBINSON and C. H. HILLS, Eastern Utilization Research Branch, Agricultural Research Service, U.S.D.A., Philadelphia 18, Pa.

4:00— 62. Some Factors Influencing Thermal Death Time Results Obtained by the Thermoresistometer Method

J. L. SECRIST and C. R. STUMBO, Food Research Dept., H. J. Heinz Company, Pittsburgh, Pa.

4:20— 63. Sterilization by Means of Spore Deactivation

C. F. SCHMIDT and W. K. NANK, Metal Division Research & Development Dept., Continental Can Company, Inc., 1350 West 76th Street, Chicago 20, Ill.

4:40— 64. A Comparative Evaluation of Methods for Determining the Bacterial Contamination of Surfaces

ROBERT ANGELOTTI, MILTON J. FOTER and KEITH H. LEWIS, Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio

TUESDAY AFTERNOON — MAY 14

Section J—Ballroom

Industry and Education

Chairman: W. A. MACLINN

3:00— 65. The Salary and Professional Picture of the Food Technologist in 1957

ROY E. MORSE, Rutgers University, Dept. of Food Technology, New Brunswick, N. J.

3:15— 66. The Time Has Come

LLOYD A. HALL, The Griffith Laboratories, Inc., 1415 W. 37th Street, Chicago 9, Ill.

3:35— 67. The Professional Society as a "Pro" Maker

SIDNEY W. F. HANSON, British Joint Services Mission (Army Staff), British Embassy Annexe, Washington 8, D. C.

3:50— 68. Additives Needed for Food Technologists

CLARENCE K. WIESMAN, Armour and Co., Food Research Dept., Union Stock Yards 9, Chicago, Ill.

4:10— 69. Toward a More Uniform Professional Training for Food Technologists

LEE J. KENYON, Preservaline Mfg. Company, Flemington, N. J.

4:25— Discussion

TUESDAY AFTERNOON — MAY 14

Section K—Terrace Room

General

Chairman: W. F. ROBERTSON

3:00— 70. Application of the Oxidation Reduction Concept to Food Problems

SIEGFRIED S. LICHTBLAU, Dept. of Chemical Engineering, City College of New York, 139 and Convent Avenue, New York 31, N.Y.

3:20— 71. Antioxidant in Malt and Malt Sprouts

DWIGHT L. BAKER and NISON N. HELLMAN, Froedtert Malt Corporation, P. O. Box 712, Milwaukee 1, Wis.

3:40— 72. Trihydroxy Butyrophenone—A Food Grade Antioxidant

BEN N. STUCKEY and W. M. GEARHART, Eastman Chemical Products, Inc., A Subsidiary of Eastman Kodak Company, Kingsport, Tenn.

4:00— 73. The Browning of Sugar Solutions. I. Effect of pH and Type of Amino Acid

C. O. WILLITS, H. G. LENTO, JR., and J. C. UNDERWOOD, Eastern Utilization Research Branch, Agricultural Research Service, U.S.D.A., Philadelphia 18, Pa.

4:20— 74. The Browning of Sugar Solutions. II. Effect of the Position of the Amino Group in the Amino Acid

H. G. LENTO, JR., J. C. UNDERWOOD and C. O. WILLITS, Eastern Utilization Research Branch, Agricultural Research Service, U.S.D.A., Philadelphia 18, Pa.

4:40— 75. Relationship Between the Type and Origin of Reducing Sugars in Sap and the Color and Flavor of Maple Sirup

LAWRENCE L. REED, J. NAGHSKI, and C. O. WILLITS, Eastern Utilization Research Branch, Agricultural Research Service, U.S.D.A., Philadelphia 18, Pa.

TUESDAY AFTERNOON — MAY 14

Section L—Pittsburgher Room

Frozen Foods

Chairman: K. G. DYKSTRA

3:00— 76. Investigation of Time-Temperature Tolerance of Frozen Foods. I. Purpose and Significance of the Investigation

G. E. HILBERT, Agricultural Research Service, U.S.D.A., Washington 25, D. C.

3:15— 77. Investigation of Time-Temperature Tolerance of Frozen Foods. II. Strawberries and Other Frozen Fruits in Retail Packages

D. G. GUADAGNI, C. C. NIMMO and EUGENE F. JANSEN, Western Utilization Research Branch, Agricultural Research Service, U. S. D. A., Albany 10, Cal.

3:40— 78. Investigation of Time-Temperature Tolerance of Frozen Foods. III. Green Peas and Snap Beans in Retail Packages

W. C. DIETRICH, F. E. LINDQUIST, H. J. NEUMANN, MILDRED M. BOGGS, G. S. BOHART and W. F. TALBURT, Agricultural Research Service, U.S.D.A., Albany 10, Cal.

4:05— 79. Investigation of Time-Temperature Tolerance of Frozen Foods. IV. Flavor Changes in Frozen Poultry Products Held at −30° to +20° F.

HANS LINEWEAVER, A. A. KLOSE, and HELEN L. HANSON, Western Utilization Research Branch, Agricultural Research Service, U. S. D. A., Albany 10, Cal.

WEDNESDAY MORNING — MAY 15

Section M—Terrace Room

Fruits and Vegetables

Chairman: A. P. SIDWELL

9:00— 80. Nonenzymatic Discoloration of Green Bean Puree

ARNOLD S. ROSEMAN, GIDEON E. LIVINGSTON and WILLIAM B. ESSELEN, Department of Food Technology, University of Massachusetts, Amherst, Mass.

9:20— 81. Preparation of New and Improved Products from Eastern (dry type) Sweetpotatoes: Chips, Dice, Julienne Strips, and Frozen French Fries

EDWARD G. KELLEY, REBA R. BAUM and CHARLES F. WOODWARD, Eastern Utilization Research Branch, Agricultural Research Service, U. S. D. A., Philadelphia 18, Pa.

9:40— 82. Factors Affecting the Consistency of Creamed Sweet Corn

ROBERT C. WILEY, AARON KORNETSKY and B. A. TWIGG, Dept. of Horticulture, University of Maryland, College Park, Maryland

10:00— 83. Studies of Processed All Green Asparagus. I. Quantitative Analysis of Soluble Compounds with Respect to Strain and Harvest Variables and Their Distribution Within the Asparagus Spear

C. DAME JR., C. O. CHICHESTER, and G. L. MARSH, Dept. of Food Technology, University of California, Davis, Cal.

10:20— 84. Studies of Processed All Green Asparagus. II. The Effect of Post Harvest Storage and Blanching Variables Upon the Chemical Composition of Processed Asparagus

C. DAME JR., C. O. CHICHESTER, and G. L. MARSH, Dept. of Food Technology, University of California, Davis, Cal.

10:40— 85. High Viscosity of Cell Wall Suspensions Prepared from Tomato Juice

R. T. WHITTENBERGER and G. C. NUTTING, Eastern Utilization Research Branch, Agricultural Research Service, Philadelphia 18, Pa.

11:00— 86. Nutritional Effects of Microwave vs. Conventional Cooking. I. Retention of Ascorbic Acid in Vegetables

CAROL CAMPBELL, BERNARD E. PROCTOR and TUNG YU LIN, Dept. of Food Technology, Massachusetts Institute of Technology, Cambridge, Mass.

WEDNESDAY MORNING — MAY 15

Section N—Ballroom

Antibiotics

Chairman: J. C. AYRES

9:00— 87. The Effects of Certain Bacterial Inhibitors in Cooling Medium on Shelf-Life of Fryers

L. E. DAWSON, J. A. DAVIDSON, W. L. MALLMANN and SUE WALTERS, Michigan State University, East Lansing, Michigan

9:20— 88. Delaying Vegetable Spoilage with Antibiotics

V. J. CARROLL, R. A. BENEDICT and C. L. WRENSHALL, Chas. Pfizer & Co., Inc., 630 Flushing Avenue, Brooklyn 6, N.Y.

9:40— 89. New Methods of Preslaughter Administration of Antibiotics

E. M. SACCHI, J. R. McMAHAN, R. C. OTTKE and C. L. WRENSHALL, Chas. Pfizer & Co., Inc., 630 Flushing Avenue, Brooklyn 6, N. Y.

10:00— 90. Further Studies on the Preservation of Beef with Chlortetracycline

JAMES M. JAY, H. H. WEISER and F. E. DEATHERAGE, Ohio Agricultural Experiment Station, The Ohio State University, Depts. of Animal Science, Agricultural Biochemistry, and Bacteriology, Columbus 10, Ohio

10:20— 91. Antibiotics in Poultry Meat Preservation: Comparison of the Tetracyclines

REESE H. VAUGHN, CHARLES W. NAGEL, E. MILES SAWYER and GEORGE F. STEWART, Depts. of Food Technology and Poultry Husbandry, University of California, Davis, Cal.

10:40— 92. Relative Efficacy of Three Tetracyclines with Poultry Meat

F. E. WELLS, J. L. FRY, W. W. MARION and W. J. STADELMAN, Purdue University, Lafayette, Indiana.

11:00— 93. The Comparative Effectiveness of Tetracycline Antibiotics for Fish Preservation

J. W. BOYD, B. A. SOUTHCOTT, E. G. BAKER, H. L. A. TARR, Fisheries Research Board of Canada, Technological Station, 898 Richards Street, Vancouver 2, B. C.

11:20— 94. The Potential Application of Antibiotics in the Salmon Canning Industry: II. Chemical and Bacteriological Evaluations

J. A. STERN, H. L. LIEBMAN, G. KUDO, J. CHAPEL, University of Washington School of Fisheries, Seattle, Washington

WEDNESDAY MORNING — MAY 15

Section O—Monongahela Room

Dehydration

Chairman: W. F. TALBURT

9:00— 95. Advances in Vacuum Dehydration in the United Kingdom

S. W. F. HANSON, British Joint Services Mission (Army Staff), British Embassy Annexe, Washington 8, D. C.

9:20— 96. Freeze-Drying of Fruits

S. JACKSON, Dept. of Food Technology, University of California, Davis, Cal.

9:40— 97. Pineapple Juice Powder

G. K. NOTTER, D. H. TAYLOR and J. E. BREKKE, Western Utilization Research Branch, Agricultural Research Service, U.S.D.A., Albany 10, Cal.

10:00— 98. Dehydrated Cooked Meat Products

R. M. BALLANTYNE, C. BRYNKO and W. R. SMITHIES, Food Research Group, Defence Research Medical Laboratories, Toronto 12, Ontario, Canada, P. O. Box 62, Postal Station "K"

10:20— 99. Quality of Dehydrated Peas in Relation to Maturity

J. C. MOYER, W. B. ROBINSON, H. R. PALLESEN and D. B. HAND, New York State Agricultural Experiment Station, Cornell University, Geneva, N. Y.

10:40—100. Production Testing of Calcium Chloride Treated Dehydrated Potatoes

RAY W. KUENEMAN and J. R. WAGNER, J. R. Simplot Company, Caldwell, Idaho and Quartermaster Food and Container Institute for the Armed Forces, 1819 West Pershing Road, Chicago 9, Illinois

11:00—101. Potato Varieties in Dehydration of Mashed Potatoes by the Flake Process

JAMES CORDING JR., RODERICK K. ESKEW, JOHN F. SULLIVAN and PAUL W. EDWARDS, Eastern Utilization Research Branch, U.S.D.A., Philadelphia 18, Pa.

11:20—102. A New Treatment of Hygroscopic Equilibria: Application to Walnuts and Other Foods

LOUIS B. ROCKLAND, Fruit & Vegetable Chemistry Laboratory, 263 South Chester Avenue, Pasadena, Cal.

WEDNESDAY MORNING — MAY 15

Section P—Pittburgher Room

Objective Quality Measurements

Chairman: W. A. GOULD

9:00—103. An Electronic Defect Counter for Measuring the Defects Factor in Foods

A. KRAMER and S. BRYAN, University of Maryland, Dept. of Horticulture, College Park, Maryland

9:18—104. Modification of the Shear Press for Electrical Indicating and Recording

R. W. DECKER, J. N. YEATMAN, A. KRAMER and A. P. SIDWELL, U.S.D.A., Quality Evaluation Section, Agricultural Marketing Service, Beltsville, Maryland

9:36—105. Textural Quality of Food Products as Determined from Force Displacement Recordings

A. KRAMER, G. L. BACKINGER, R. W. DECKER and A. P. SIDWELL, University of Maryland, Dept. of Horticulture, College Park, Maryland, and Agricultural Marketing Service, U.S.D.A., Beltsville, Maryland

9:54—106. A Strain Gage Pea Tenderometer Instrument Description and Evaluation

S. DAVISON, A. L. BRODY, B. E. PROCTOR and P. FILSENTHAL, Dept. of Food Technology, Masachusetts Institute of Technology, Cambridge, Mass.

10:12—107. The Application of Specific-Gravity Techniques for the Evaluation of Quality of Sweet Corn

THOMAS M. CRAWFORD and WILBUR A. GOULD, Ohio Agricultural Experiment Station and The Ohio State University, Columbus, Ohio

10:30—108. Non-destructive Measurement of the Internal Color of Tomatoes

G. S. BIRTH, K. H. NORRIS and J. N. YEATMAN, USDA, AMS, MRD, BSB, Quality Evaluation Section, 105A South Wing Administration Building, Plant Industry Station, Beltsville, Maryland

10:48—109. Objective Criteria for Storage Changes in Tomato Paste

B. S. LUH, S. J. LEONARD and G. L. MARSH, Dept. of Food Technology, University of California, Davis, Cal.

11:06—110. Objective Evaluation of Color and Consistency in Peach Puree

D. E. WILSON, J. C. MOYER, W. B. ROBINSON and D. B. HAND, New York State Agricultural Experiment Station, Cornell University, Geneva, New York

WEDNESDAY AFTERNOON — MAY 15

Ballroom

General Session

2:00— APPERT AWARD ADDRESS

WEDNESDAY AFTERNOON — MAY 15

Section Q—Monongahela Room

Statistical Quality Control

Chairman: C. B. WAY

3:00—111. A Quality Control Approach to Optimum Machine Set-Up

CHARLES L. SMITH and ROBERT B. FRY, Continental Can Company, Inc., 100 E. 42nd Street, New York, N. Y.

3:20—112. SQC Approach to the Use of Multiple Regression in Food Research

MAE-GOODWIN TARVER and ANNA MAY SCHENCK, Metal Division Research & Development Dept., Continental Can Company, Inc., 1350 West 76th Street, Chicago 20, Illinois

3:40—113. Statistical Construction of Objective Quality Scales

MAE-GOODWIN TARVER and ANNA MAY SCHENCK, Metal Division Research & Development Dept., Continental Can Company, Inc., 1350 West 76th Street, Chicago 20, Illinois

4:00—114. Application of SQC Procedures to the Canning of Green Beans

A. KRAMER and B. A. TWIGG, University of Maryland, Dept. of Horticulture, College Park, Maryland

4:20—115. Sampling Plans Developed by U.S.D.A. for Inspection of Processed Fruits and Vegetables

R. P. BARTLETT, JR. and J. B. WEGENER, Agricultural Marketing Service, U.S.D.A., Washington 25, D. C.

4:40—116. On the Application of Linear Programming to the Optimal Choice of Raw Materials

JAROSLAV TUZAR, Salerno-Megowen Biscuit Company, 4500 W. Division Street, Chicago 51, Illinois

WEDNESDAY AFTERNOON — MAY 15

Section R—Terrace Room

General

Chairman: C. R. HAVIGHORST

3:00—117. Control of Moisture in Granular Products

WM. J. SCARLETT, Minneapolis Honeywell Regulator Company, Wayne and Windrim Avenues, Philadelphia 44, Pa.

3:20—118. Continuous Laboratory-Scale Jelly Manufacture

J. D. PONTING, D. W. SANSHUCK, and J. E. BREKKE, Western Utilization Research Branch, Agricultural Research Service, U.S.D.A., Albany 10, California.

3:40—119. High-Density Fresh Flavor Peach Concentrates by a Continuous Process

NELSON H. EISENHARDT, NICHOLAS C. ACETO, JOSEPH B. CLAFFEY, and CLIFFORD S. REDFIELD, Eastern Utilization Research Branch, Philadelphia 18, Pa.

4:00—120. Effects of Jar Size, Liquor, and Product-to-Liquor Ratio on Heating Characteristics of Fresh-Packed Pickle Products

R. C. NICHOLAS, I. J. PFLUG, and R. N. COSTILOW, Michigan State University, Agricultural Experiment Station, East Lansing, Mich.

4:20—121. Heat Conduction Through Thermocouple Wire a Factor in Heat Penetration Measurement

J. L. SEGMILLER and C. R. STUMBO, Food Research Dept., H. J. Heinz Company, Pittsburgh, Pa.

4:40—122. Eliminating Pressure Canning of Vegetables

ROBERT V. MORSE, Robert V. Morse Research Laboratory, 521 Wyckoff Road, Ithaca, New York.

WEDNESDAY AFTERNOON — MAY 15

Section S—Ballroom

Chemicals in Foods

Moderator: F. N. PETERS

3:00— Panel Discussion Sponsored by the IFT Committee on Chemicals in Foods

Developments in the technological application of chemical additives in food processing will be reported by the Panel and from the floor, with particular reference to the public health and legal aspects.

The recent and current activities of the Food Protection Committee of the National Research Council, of the current session of Congress, and of various international organizations will be discussed and, it is hoped, debated informally.

IFT Committee on Chemicals in Foods

F. L. Gunderson, Chairman
L. E. Clifcorn
F. J. Francis
R. D. Gerwe
B. L. Oser
F. N. Peters
J. J. Powers
H. C. Spencer

WEDNESDAY AFTERNOON — MAY 15

Section T—Pittsburgher Room

Frozen Foods

Chairman: H. P. SCHMITT

3:00—123. Stability of Frozen Concentrated Orange Juice. IV. Seasonal and Varietal Factors as Related to Heat Stabilization

O. W. BISSETT, M. K. VELDHUIS, R. B. GUYER, and W. M. MILLER, U. S. Citrus Products Station, Winter Haven, Florida, and Continental Can Company, Inc., Metal Division Research and Development Dept., 1350 W. 76th Street, Chicago 20, Illinois.

3:20—124. Stability of Frozen Concentrated Orange Juice. V. Effect of Heat Treatment at Intermediate Stages of Concentration on Juices Prepared from Valencia Oranges

E. A. CARROLL and R. B. GUYER, O. W. BISSETT and M. K. VELDHUIS, Continental Can Company, Inc., Metal Division Research & Development Dept., 1350 W. 76th Street, Chicago 20, Ill., and U. S. Citrus Products Station, Winter Haven, Fla.

3:40—125. A Two-Season Survey on the Flavor of Florida Frozen Concentrated Orange Juices

F. W. WENZEL and R. W. OLSEN, Florida Citrus Experiment Station, and Florida Citrus Commission, Lake Alfred, Florida.

4:00—126. Factors That Determine Storage Conditions Necessary to Maintain the Quality of Frozen Citrus Concentrates

F. W. WENZEL, E. L. MOORE, and R. L. HUGGART, Florida Citrus Experiment Station and Florida Citrus Commission, Lake Alfred, Fla.

4:20—127. Color Stability of Frozen Beef as Influenced by Illumination, Temperature and Storage

H. D. NAUMANN, J. L. McBEE, JR., and D. E. BRADY, University of Missouri, Columbia, Mo.

4:40—128. Factors Affecting the Stability of Frozen White Sauces

ELIZABETH M. OSMAN and PATRICIA D. CUMMISFORD, Michigan State University, East Lansing, Mich.

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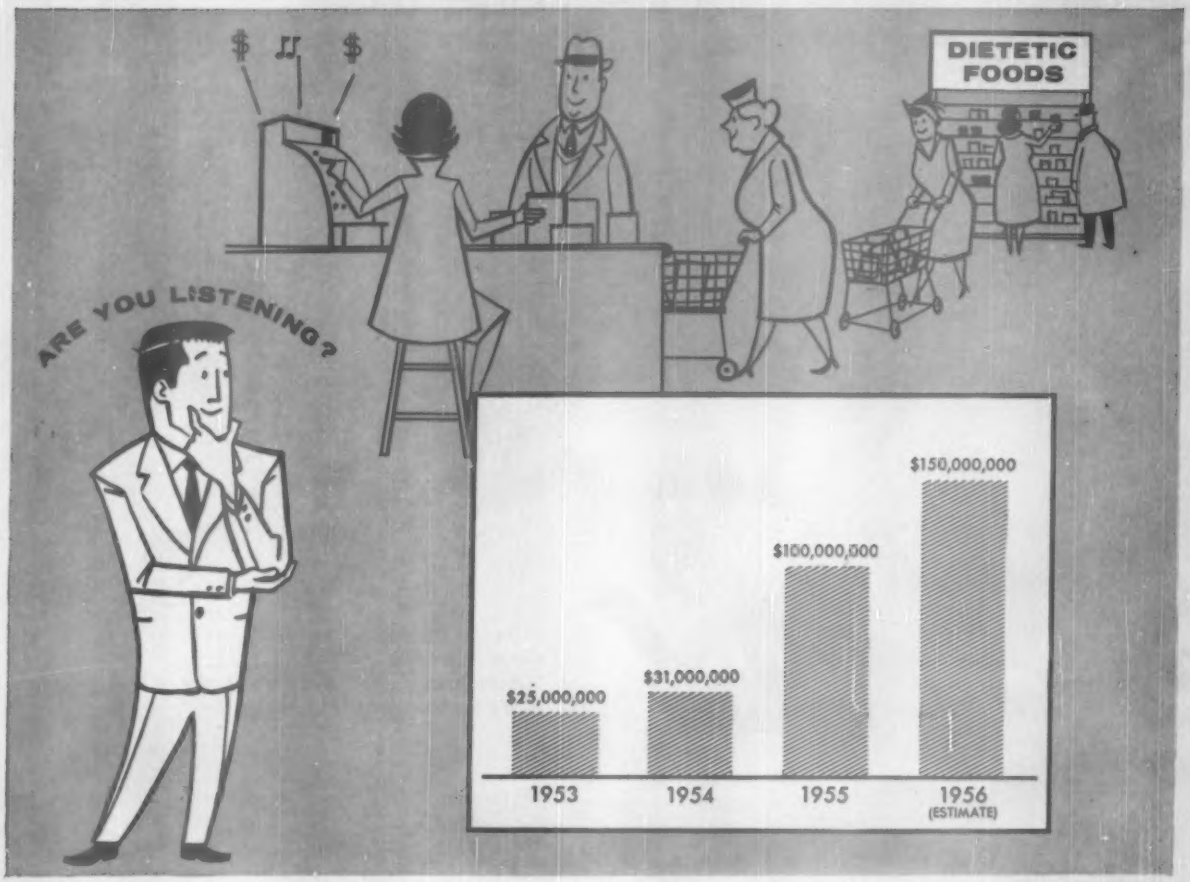

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Thursday—May 16

Ballroom

The Methodology of Sensory Testing

Chairman: ERNEST E. LOCKHART

9:00— Introductory Remarks

ERNEST E. LOCKHART, The Coffee Brewing Institute, Inc., New York 17, New York.

9:10—129. Panels of Judges for Foods and Beverages

W. FRANKLIN DOVE, College of Medicine, University of Illinois, Chicago 12, Illinois.

9:50—130. Selection of a Taste Panel for Evaluating the Quality of Processed Milk

MARY E. KIRKPATRICK, JESSIE LAMB, and ELSIE H. DAWSON, Human Nutrition Research Branch, Agricultural Research Service, U.S.D.A., Washington 25, D. C.

10:30—131. The Hedonic Scale Method of Measuring Food Preference

DAVID R. PERYAM and FRANCIS J. PILGRIM, Quartermaster Food and Container Institute for the Armed Forces, Chicago 9, Illinois.

11:10—132. Methods for Rating Quality and Intensity of the Psychological Properties of Foods

NOEL SCHWARTZ and DEAN FOSTER, United States Testing Company, Inc., Hoboken, New Jersey.

11:40— Discussion

2:00—133. Methodology of Flavor Profile

L. B. SJÖSTRÖM, S. E. CAIRNCROSS, and J. F. CAUL, Arthur D. Little, Inc., 30 Memorial Drive, Cambridge 42, Massachusetts.

2:40—134. Consumer Acceptance Methodology: One vs. Two Samples

MARION SIMONE and ROSE MARIE PANGBORN, Dept. of Food Technology, University of California, Davis, California.

3:20—135. Studies Leading to the Development of a Simplified "Uniform Procedure" for Making Flavor Difference Evaluations of Canned Foods

CHARLES H. MAHONEY, HOWARD L. STIER, and EDWIN A. CROSBY, National Canners Association, Washington 6, D. C.

4:00—136. The Northeast Regional Approach to Collaborative Panel Testing

ROBERT C. WILEY, Dept. of Horticulture, University of Maryland, College Park, Maryland.

4:30— Discussion

ABSTRACTS

1

U. S. PUBLIC HEALTH SERVICE ACTIVITIES CONCERNING INDUSTRIAL WASTES

L. F. WARRICK
Public Health Service, Department of Health, Education, and Welfare
Washington, D. C.

Water demands in our national economy are steadily increasing. Experience has indicated need for integrated programs for conserving water resources. A wide variety of tasks are included in planning and developing programs directed toward improvement of the quality of the nation's waters. Such tasks involve solution of technical, legal, and economic problems, each needing careful consideration if goals are to be achieved on a practical basis. These problems are being given attention in the development of activities under the Federal Water Pollution Control Act, as well as in regional, state, and local programs. Industry interest and participation in clean water programs is steadily growing. The creation of the National Technical Task Committee on Industrial Wastes, on invitation of the Surgeon General of the Public Health Service, is one of the cooperative steps taken by industry in the nation-wide activities to abate pollution. Illustrations provided indicate progress being made by the Food Industry. Research and application of results where needed in solving waste problems are stressed. Teamwork is advocated in the tasks ahead.

2

THE ROLE OF STATE SANITARY COMMISSIONS IN WASTE CONTROL

F. B. MILLIGAN
Division of Sanitary Engineering, Pennsylvania Department of Health
Harrisburg, Pennsylvania

Reasons for pollution control are given; namely, to protect water resources for industrial and agricultural use as well as for domestic supplies and recreation.

Polluting effects of industrial and agricultural wastes are described, including: acids and toxic metal salts from metallurgical plants; taste- and odor-producing phenols from by-products coke plants; inert material from collieries, sand washeries, and above all, soil erosion including that from farms, which may blanket stream beds and smother aquatic life; radioactive wastes from nuclear reactors and from some users of radio-isotopes; oil and other objectionable material from petroleum refineries; decayable substances from food-processing establishments such as canneries, abattoirs, and milk plants, and from pulp and paper mills, tanneries, textile mills, and from almost all other water-using industries.

The development of laws for the control of stream pollution is presented, with Pennsylvania used as an example. State commissions for control of wastes with respect to water pollution, their functions and operation, are discussed. The Pennsylvania Sanitary Water Board's policies and program, again as an illustration, are explained. How industry action committees have cooperated with the Pennsylvania Board from outset will be told. Interstate agreements and compacts—INCODEL, INCOPOT, ORSANCO and others—are discussed.

3

THE PROGRAM OF THE NATIONAL CANNERS ASSOCIATION ON WASTE DISPOSAL

ROBERT A. CANHAM
National Canners Association
Washington, D. C.

During the past thirty years the National Canners Association has had an active program under way to study the waste disposal problems of the canning industry in an attempt to provide solutions and improvements to methods of treatment.

Since 1927 there have been changes in approach to the problem and changes in the requirements as outlined by the state regulatory authorities. During this period the following methods of treatment have been or are being used:

1. Mechanical
   (a) Screening
2. Chemical Treatment
   (a) Chemical Precipitation

3. Biological Treatment
   (a) Filtration
   (b) Aeration
   (c) Impounding Lagoons
4. Land Methods of Disposal
   (a) Impounding Lagoons
   (b) Absorption Beds
   (c) Ridge and Furrow Irrigation
   (d) Spray Irrigation
5. Discharge to Municipal Sewage Systems

Brief discussions of these methods are made with the emphasis placed on their advantages and disadvantages.

A discussion is given of new developments and considerations for future lines of research as related to canning waste disposal.

4

PROBLEMS IN HANDLING POULTRY WASTES

A. JOEL KAPLOVSKY
Delaware Water Pollution Commission
Dover, Delaware

This discussion will include the characteristics of poultry wastes, equivalent population load, the advantages and disadvantages of segregation, and suggested methods for handling the various segments. Possible application to the meat processing industry will be indicated.

5

APPLICATION OF LABORATORY STUDIES TO PRACTICAL DAIRY WASTE DISPOSAL

NANDOR PORGES
Eastern Utilization Research Branch, Agricultural Research Service, U. S. Department of Agriculture
Philadelphia, Pennsylvania

Pollution effect of a food waste is a measure of the oxygen required for its stabilization. Dairy waste is considered a strong waste difficult to treat. However, laboratory studies show that by satisfying basic oxygen requirements this waste can be treated by aeration. Conversion of organic solubles to insoluble and harmless material is a biological process carried out by microorganisms. Complete combustion of 1 lb. of organic matter requires 1.2 lb. oxygen. Conversion to bacterial cells requires only 0.45 lb. of oxygen that must be supplied at high rates depending on the concentration of the seed bacteria. About half of the organic matter is dissipated while half is found as cell substance. The remaining 0.75 lb. of oxygen demand is used slowly by the cells during endogenous respiration. Equations showing these changes and data derived from laboratory studies are presented.

This information was applied to studies in a 10,000 gallon pilot plant at Pennsylvania State University. Designs were developed for treating dairy waste by a fill-and-draw one-tank procedure and by a continuous flow method and are described. These are less costly than conventional methods and are now in practical use at a number of dairies.

Means of treating food wastes are suggested by these laboratory and pilot plant studies.

6

PROBLEMS IN BRANDY STILLAGE IN A MUNICIPAL WASTE TREATMENT PLANT

REESE H. VAUGHN, GEORGE K. YORK II, MELVIN F. KLEMMICK, and L. DOUGLAS DAVIS
Department of Food Technology, University of California, Davis, Calif., Sonoma County Sanitary District, Sonoma, Calif., and Sabastianni Winery, Sonoma, Calif.

Circumstances arose that required purification of brandy stillage in a plant designed exclusively for treatment of municipal wastes. Therefore, immediate translation of previous laboratory studies to full-scale treatment of the stillage was attempted.

Successful disposal of the brandy stillage in the municipal plant was accomplished by treating the still effluent with $Ca(OH)_2$ and $CaCl_2$ to remove tartrate and increase the pH. The detartrated waste then was diluted with still condenser water before leaving the winery. The diluted waste received further dilution with municipal waste in its travel through about 3 miles of sewerage system pipeline between the winery and the treatment plant. With this method of pre-treatment the over-all reduction in 5-day B.O.D. accomplished by the treatment plant was 88%. When the system handled only municipal waste the over-all reduction in 5-day B.O.D. was increased slightly to 91%. Observations extending over a two-year period concerned with both conventional brandy stillage and lees brandy stillage will be discussed in detail.

7

ACCELERATING THE PROTEIN CYCLE IN NATURE: FOOD FROM MUNICIPAL WASTES

ROBERT V. MORSE
Robert V. Morse Research Laboratory
521 Wyckoff Road, Ithaca, N. Y.

The protein cycle—from soil to grain to animal to man to soil—usually takes a year. The Rahn process using municipal sewage and whey (both waste products) with algae in the vegetable kingdom in place of corn, can produce forty high protein crops per year with nutritional benefit to man and reduction in the cost of waste disposal.

8

HEMATIN COMPOUND CATALYZED OXIDATIVE FAT RANCIDITY

V. P. MAIER and A. L. TAPPEL
Department of Food Technology, University of California
Davis, California

The hemoproteins—hemoglobin and myoglobin—have been established as the principal catalysts responsible for the oxidation of unsaturated fats in meat and meat products. In order to obtain a better understanding of the reactions involved in this oxidative process a study was made using model systems. These included both heterogeneous and homogeneous solutions of fatty acids and fatty acid hydroperoxides with various hematin compounds as catalysts.

The initial step of the oxidative process involves a direct reaction between the catalyst and the fatty acid hydroperoxide to produce free radicals and to regenerate the catalyst. The free radicals then react with oxygen and fatty acids to set up a chain reaction which eventually leads to the formation of the odoriferous compounds characteristic of oxidized fats. Certain details of these reactions will be presented and their bearing on oxidative fat rancidity discussed.

9

REFLECTANCE SPECTRAL STUDIES OF MEAT PIGMENTS

A. L. TAPPEL and V. P. MAIER
Department of Food Technology, University of California
Davis, California

Direct reflectance spectra of meats are nearly ideal for the identification of hematin pigments and their derivatives. Although much more diffuse than absorption spectra the reflectance spectra of hematin compounds have enough characteristic maxima and minima in the regions 500-600 mμ and 400-425 mμ to allow identification. The major advantage is that this method requires no extraction treatment which might introduce errors.

Reference reflectance spectra of normal meat pigments and their derivatives have been obtained and some typical examples will be shown.

Reflectance spectra have proven useful in the following studies.

1. Identification of the pigments of cooked meats as denatured globin nicotinamide hemichromes.
2. Identification of the pink pigment of canned tuna.
3. Pigment changes induced by radiation of meats.
4. Composition of the pigments of freeze-dried meats.

Results of these studies will be illustrated with reflectance spectra.

10

PIGMENT CHANGES IN PACKAGED BEEF DURING STORAGE

PAUL C. PIRKO and JOHN C. AYRES
Dairy and Food Technology Departments, Iowa State College
Ames, Iowa

Pigment changes of beef packaged with different wrapping materials are reported. Surface discolorations were measured by means of reflectance spectrophotometry and were associated with oxidation or oxygenation of myoglobin. Exposure of fresh beef to air for 25 minutes prior to packaging was not found to alter pigment interchange upon storage.

The several packaging materials used were divided into three classes as follows: I. Those with which metmyoglobin formation increased during storage and not reaching a maximum until the sixth day. II. Those with which maximum metmyoglobin formation occurred on the fourth day of storage. III. Those with which maximum metmyoglobin formation occurred on the first day of storage.

The effect of vacuum packaging on discoloration was studied as was also excessive loss of water from the meat tissue.

11

CONTAINER PROBLEMS ASSOCIATED WITH THE ADDITION OF PHOSPHATES TO THE CURING INGREDIENTS OF PORK PRODUCTS

B. J. McKernan, R. B. Davis, J. F. Fox, and O. C. Johnson
Continental Can Company, Inc.
Chicago, Illinois

The introduction of phosphates as additives to curing ingredients for pork products posed a number of problems to can manufacturers. Packing phosphate-treated product in plain body containers resulted in unpredictable corrosion of the plain tinplate and discoloration of the meat. The simple expedient of using a container enameled throughout with a conventional meat type enamel was not an immediate solution. This paper reviews the search for satisfactory container specifications.

Studies of containers were conducted with respect to the relative effects produced by several phosphates and on the possible cumulative effects of these phosphates and the curing ingredients. Investigations were made of the relative effects of sterile versus pasteurizing processes. The role played by product quality with respect to container performance was also examined.

12

RELATIONSHIPS BETWEEN POLYPHOSPHATES AND SALT IMPURITIES IN HAM CURING

Ove Madsen, George D. Wilson, and C. Edith Weir
American Meat Institute Foundation
Chicago, Illinois

Experiments were conducted to determine the effect of the impurities found in other than calcium-free salts on the quality and yield of hams cured with commercially available phosphates. The amount and kind of precipitate formed in the curing pickles and on the finished product were also determined.

In preparing pickles containing 15.8% salt, large amounts of precipitate were formed immediately when salt containing 2% calcium sulfate was used in combination with 2% sodium tripolyphosphate or in combination with a mixed phosphate containing sodium pyrophosphate. Calcium sulfate and dextrose had an inhibiting effect on the precipitation of sodium tripolyphosphate in pickles held at 42° F. Crystal formation on the finished hams was also retarded by the inclusion of calcium sulfate in the phosphate pickle. White crystals formed on the exterior and cut surfaces of all hams pumped with a 5% sodium tripolyphosphate pickle. These crystals were identified as disodium phosphate with a varying amount of water of hydration.

The impurities normally encountered in rock salt had no effect on the yield of processed hams. The increased yield noted in the tripolyphosphate treated hams over the control hams appeared to be only partially related to the increase in pH. Yield and pH were similarly related in the hams containing no added phosphate. The carbon dioxide immobilization of hogs prior to bleeding did not result in a more homogeneous group of experimental hams, with respect to pH, than did conventional slaughter procedures.

Quality, as determined by aroma, flavor, tenderness and texture, was unaffected by either the added phosphates or impurities.

13

EFFECT OF CERTAIN PHOSPHATES ON THE WATER HOLDING CAPACITY OF MEAT

Kaisri Poshyachinda and F. E. Deatherage
Department of Agricultural Biochemistry
Ohio Agricultural Experiment Station
and The Ohio State University
Columbus, Ohio

Solutions of sodium orthophosphate ($NaH_2PO_4 + Na_2HPO_4$), pyrophosphate ($Na_2H_2P_2O_7 + Na_4P_2O_7$), and tripolyphosphate ($Na_5P_3O_{10}$) adjusted to pH 5.6 by HCl were added to meat separately at the ratio of 1:10. Solutions of three levels of ionic strength, i.e. 0.70, 0.49, and 0.30, were prepared so that each phosphate at the same ionic strength would contain the same amount of chloride ions. These solutions did not affect the amount of juice released regardless of the cooking temperature.

Since phosphates are among the most powerful complexing agents for Ca^{++} and Mg^{++}, inactivation of Ca^{++} and Mg^{++} should not be responsible for improvement of water holding capacity of meat after cooking.

Sodium orthophosphate (without sodium chloride) adjusted to pH 5.6 did not affect the juice expressed on cooking whereas sodium chloride with the same total ionic strength as that of phosphate, (i.e. 1.38, 0.74, 0.50) decreases the amount of juice.

However, when the effect of phosphate was compared with that of chloride solutions which contained the same concentration of Na^+, phosphate was much more effective than chloride. This might be due to the difference in total ionic strength.

14

THE EFFECT OF VARIOUS ADDITIVES ON THE STABILITY OF CURED MEAT

A. M. Mullins, G. G. Kelley, and D. E. Brady
Animal Husbandry Department
University of Missouri
Columbia, Missouri

Hot pork carcasses were pumped with a mixture of sodium ascorbate, salt, sugar, and sodium nitrite. Dispersion and color production were determined and found to be good. Chemical and natural products were added to enhance color stability, stability against rancidity, and increased dispersion. Smoking was done with and without heat.

15

SHRINKAGE AND ORGANOLEPTIC CHARACTERISTICS OF BEEF AGED IN CONTROLLED ENVIRONMENTS

R. B. Sleeth, G. G. Kelley, and D. E. Brady
Food Processing Laboratories
Missouri Agricultural Experiment Station
Columbia, Missouri

The effect of various temperature, humidity, air flow, and ultraviolet radiation conditions has been studied on paired beef quarters and wholesale cuts of different weights and grades. Determinations were made of shrinkage, color, drip loss, and cooking loss; organoleptic responses reflecting the differential effects of the various aging treatments were studied. Effect of the different treatments on sensory values of rib and round steaks after 2, 4, 8, and 12 months' storage at 0° F. has been ascertained.

A method of predicting shrinkage and organoleptic characteristics of beef aged under controlled environmental conditions is presented.

16

EFFECTIVENESS OF COMMERCIAL PAPAIN IN MEAT TENDERIZATION

Shirley Weiner, Margaret Mangel, Leta Maharg, and G. G. Kelley
Home Economics Department
University of Missouri
Columbia, Missouri

Twenty-three commercially available papain products were studied for efficiency of meat tenderization, chemical and physical properties, and the best conditions for activity.

The pH of the preparations was variable, and those compounds with a low pH were most efficient at low temperatures. The preparations with pH about neutral were effective at high temperatures. Three products were completely ineffective.

Errors inherent in meat tenderizers are discussed.

17

PINKING OF ONIONS DURING DEHYDRATION

Thomas M. Lukes
Gentry Division, Consolidated Foods Corporation
Gilroy, California

Onions, during the dehydration process, will at times develop a pink discoloration in some of the pieces. This used to be considered a sign of serious bacterial contamination. On investigation it was found that the juice of fresh onions could be made to turn pink even though it had been sterilized by chemical means, demonstrating that bacteria are not the cause of the pinking. Subsequent investigation revealed that the reaction was a two-step biochemical reaction. The first step is enzymatic in nature and produces a colorless compound which in turn reacts non-enzymatically with the amino-acids in the onion juice to produce the pink pigment.

18

GLUCOSE OXIDASE IN THE PROTECTION OF FOODS AND BEVERAGES

R. R. Barton, S. S. Rennert, and L. A. Underkofler
Takamine Laboratory Division of Miles Laboratories, Inc.
Clifton, N. J.

Glucose oxidase catalyzes the oxidation of glucose by molecular oxygen. Food products subject to deterioration because of the presence of glucose are protected against such changes by the enzymatic oxidation of the glucose in the product before packaging or drying. Enzyme stabilization of dried eggs and other foods will be discussed as illustrative of this application. Foods and beverages susceptible to oxidative deterioration may be protected by the removal of residual oxygen from the food and container by means of glucose oxidase. Results will be presented showing the protection against flavor changes and container corrosion afforded by glucose oxidase treatment of certain foods and beverages. Methods of application of the enzyme for protection of both hydrated and dehydrated products will be discussed.

19

THE GLUCOSE OXIDASE-CATALASE SYSTEM AS AN OXYGEN SCAVENGER FOR HERMETICALLY SEALED CONTAINERS

GEORGE W. KURTZ and YUMIO YONEZAWA
Quartermaster Food and Container Institute
for the Armed Forces
Chicago, Illinois

The susceptibility of dried or dehydrated foods to oxidative deterioration is well known. Present methods of packaging successfully remove most of the oxygen present in a hermetically sealed container. However, the small amount of oxygen remaining is often sufficient to cause deterioration of the contained product. The glucose oxidase-catalase system, together with substrate, buffer and filler, has been enclosed in a semi-permeable membrane and packaged with a food product (dry whole milk). Evidence is presented to show that oxygen is removed from the headspace gas of the container in a relatively short time following sealing of the container. Chemical tests for oxidative deterioration of the food show that there is practically no oxidation during a storage period of one year at either 70° F. or 100° F. Preliminary subjective measurements show improved acceptability of the product stored with the enzyme system.

20

A METHOD OF ENHANCING FLAVOR ENZYME SYSTEMS

S. DAVID BAILEY
Quartermaster Research and Development Center
Natick, Massachusetts

The role of enzymes in the release of natural flavors in foods is one of considerable interest to the Quartermaster in supplying acceptable rations for the Army supply system. Preliminary studies which have taken place during the last year indicate that considerable promise is held for the proper utilization of enzymes at the time that a food is prepared for consumption. The preparations used in the extraction of crude enzymes for use in flavor propagation are described. Also described is the procedure for the preparation of suitable precursors on which the enzymes are required to act. The evaluation of the interaction of enzyme precursor will be presented and a number of different enzymatic isolation procedures will be compared. Studies have demonstrated that the pH of the enzyme precursor reaction is important in the maximum release of the natural flavor. Preliminary results of these tests will be given. There is considerable promise in the use of physical-chemical means of demonstrating the release of flavors by enzymatic action exclusive of sensory panel testing. Preliminary results of these studies will be given and compared to sensory panel taste tests.

21

APPLICATION OF PEROXIDASE TEST PAPER IN FOOD PROCESSING

HERMAN J. MORRIS
Western Utilization Research Branch, Agricultural Research Service, Department of Agriculture
Albany, California

A brief description of the test paper for detecting peroxidase will accompany data showing its possible application in food processing. Results obtained with the test paper will be compared with results obtained by published methods on several kinds of vegetables of varying peroxidase activities. From the data presented, it will be possible to evaluate the degree of peroxidase inactivation using the test paper results.

22

APPLICATION OF GAS CHROMATOGRAPHY TO STUDIES OF OFF-FLAVORS DEVELOPED DURING FROZEN STORAGE OF ENZYME SYSTEMS

PAUL A. BUCK
Department of Dairy and Food Industries
University of Wisconsin
Madison, Wisconsin

In 1955 and again in 1956, samples of the Perfection variety of green peas were taken at a vining station, at a cannery, and at several stages during the process at the cannery. At the same time, peas still in the pod were collected from the field being harvested, and analyzed before and after freezing. Samples were stored frozen at −10° F. after being quickly frozen in a plate freezer. Organoleptic evaluations of the samples were made at each six-month interval. Homogenates and crude enzyme preparations were prepared and studied mainly by manometric techniques using a refrigerated Warburg instrument equipped with ultraviolet lamps and quartz manometer flasks to restrict bacteriological spoilage during prolonged tests. The gaseous exchange from the homogenates and enzyme preparations was measured at constant temperatures over the range of 30° C. to −23° C., and at fluctuating temperatures from 0° C. to −23° C. Glycerol was added to enzyme preparations in order to imitate the natural pea systems under storage at freezing temperatures. The gases were analyzed by gas chromatography using various columns at 65° and 100° C. Characterization of the products of enzyme activity has been limited to comparison of the partition coefficient of unknown to known compounds.

Similar studies are being conducted with corn, and by slightly modified procedures with broccoli.

23

EFFECT OF SORBIC ACID ON FILM-FORMING YEASTS AND MOLDS IN DIFFERENT CONCENTRATIONS OF SALT IN CUCUMBER BRINE STOCK

A. H. JONES and T. W. HUMPHREYS
Bacteriology Division, Science Service
Canada Department of Agriculture
Ottawa, Canada

Sorbic acid at a concentration of 0.1% added to the brine of cucumber stock effectively inhibited film-forming yeasts in concentrations of salt ranging from 3 to 10%. Some molds were resistant to the sorbic acid. Any retarded fermentation noted was definitely associated with the concentration of salt rather than the sorbic acid. The ratio of cucumbers to salt brine had a decided influence on the effectiveness of the sorbic acid. Data are presented on residual sorbic acid at various stages of the curing process.

24

SORBIC ACID AS A SELECTIVE AGENT IN CUCUMBER FERMENTATIONS. III. EVALUATION OF SALT STOCK FROM SORBIC ACID TREATED CUCUMBER FERMENTATIONS

RALPH N. COSTILOW
Department of Microbiology and Public Health
Michigan State University
East Lansing, Michigan

It has been demonstrated a number of times that gaseous fermentations by yeasts are often responsible for bloater spoilage of cucumber salt stock. Therefore, a 3-year study has been completed on the use of sorbic acid in cucumber fermentations to inhibit yeast growth. This involved a total of 141 experimental fermentations testing sorbic acid concentrations ranging from 0.01 to 0.10%. The salt stock from these fermentations was evaluated with respect to percent bloaters, firmness, and color. In most instances, sorbic acid treatment reduced the percentage of bloaters, but it did not completely eliminate them. There was no significant effect of the treatments on the firmness, and sorbic acid levels below 0.05% did not affect the color of the stock. However, a definite bleaching was observed frequently with 0.1% and occasionally with 0.05% sorbic acid.

25

VITAMIN K_5 AS A PRESERVATIVE FOR WINE

J. N. CASPER and H. Y. YANG
Food Technology Department
Oregon State College
Corvallis, Oregon

Sulfur dioxide has been used as a chemical preservative for wine for many years. At the present time, it is still the only legal preservative for wine. Use of sulfur dioxide, however, results in many disadvantages—such as the development of undesirable flavor, interference with aging, and the formation of precipitates and turbidity.

Previous investigation by the authors showed that at 7 p.p.m., Vitamin K_5 is effective in preventing secondary fermentation in light sweet wines.

Present work was done using Vitamin K_5 as preservative in controlling the development of volatile acids. Results showed that K_5 was not nearly as effective in controlling the development of volatile acids as it was in controlling secondary fermentation. Concentrations as high as 50 p.p.m. did not completely stop the development of volatile acids.

Microbiological studies showed that K_5 was very effective in killing *Saccharomyces ellipsoideus*. Small concentrations of K_5 have shown nearly 100% effectiveness.

26

ABSORPTION OF SALT by CUCUMBERS

CARL S. PEDERSON and MARGARET N. ALBURY
New York State Agricultural Experiment Station
Cornell University
Geneva, New York

Among many factors the fermentation and curing of cucumbers is influenced by the concentration of salt. It would seem that the rate of salt absorption would affect the relative degree of bloating of cucumber salt stock. A study was made of the penetration of salt into cucumbers of various maturities. The effect of cutting stems of overmature cucumbers was observed. The course of penetration was followed by salt analysis of tissues and by dye penetration studies.

The more important mode of penetration of salt into the cucumber appeared to occur through the fibrovascular system, although penetration is also effected through the epidermal system. Any factor such as drying or over-maturity which tends to block or seal the fibrovascular system seemed to cause excessive bloating.

27

SOFTNESS IN SALT-STOCK PICKLES

RAUNO A. LAMPI, WILLIAM B. ESSELEN,
EDWARD E. ANDERSON, and CECIL L. THOMSON
Department of Food Technology
University of Massachusetts
Amherst, Massachusetts

Factors influencing the firmness of salt stock pickles were studied over a period of 3 years by periodic bacteriological, chemical, and physical examinations of several commercial fermentations and of small scale experimental fermentations. Results indicated that several factors may be interrelated in causing softening. As aids in preventing softening (as indicated by low pressure tester results), best results were obtained by draining brines 1 to 6 days after salting, heating brines sufficiently to destroy enzymes 1 to 6 days after salting, or using salt concentrations in the original brines of 30° Salometer or higher. Addition of small amounts of calcium salts to the brines was of some aid in maintaining firmness. Addition of sufficient acetic acid to the initial brine to lower the pH below 4.5 did not prevent the occurrence of pectolytic enzyme activity. Addition of an excess of cucumber blossoms to the barrels during the brining operation resulted in soft salt stock. However, the use of thoroughly washed and deflowered cucumbers varied, yielding firm salt stock one season and soft salt stock the next. Size and maturity were not important factors in relation to softening.

A lack of correlation between pectolytic enzyme activity and pressure test results was noted, especially among different varieties and among cucumbers of the same variety grown in different local areas. Some cucumber varieties were found to be basically more resistant to softening than others.

28

PREPARATION OF CANNED CARBONATED CIDER FROM DESSERT VARIETIES

F. E. ATKINSON and J. F. BOWEN
Fruit and Vegetable Processing Laboratory
Experimental Farm, Canada Department of Agriculture
Summerland, B. C.

An acceptable cider containing 4.25% alcohol by volume has been prepared from juice of the Delicious variety sweetened with apple concentrate. Results are presented of tests with a number of strains of wine yeasts, effects of types of concentrates on flavor, and suitability of dessert varieties.

29

SOME NEWER CHEMICAL VIEWS OF COFFEE

FREDERICK R. GREENBAUM
Kwik Kafe Coffee Processors of America, Inc.
Hatboro, Pennsylvania

Under the impetus of the Coffee Brewing Institute, Inc., considerable research on the chemical aspects of coffee has been carried out. Some of the high points of our newer knowledge are presented.

Two outstanding Swiss chemists have shown that the aroma is composed of 70 different chemical compounds. Nine organic acids have been identified to be present in coffee, of which chlorogenic acid is the most important. It is believed that chlorogenic acid has something to do with the flavor of coffee. It has been established that 3 important vitamins—niacin, riboflavin, and ascorbic acid—are contained in coffee, imparting nutritional value to the beverage. Paper chromatography has definitely established the presence of certain essential amino acids and other break-down products of proteins which are of importance in nutrition. Since water plays an important role in coffee making, some of the essential requirements of the water used are brought out. Some of the problems that face the research man in the coffee field are (1) the effect on aroma and flavor formation of the degree of roasting and (2) a means of checking color.

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STORAGE PROPERTIES OF VACUUM-PACKED COFFEE

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The effect of storage temperature and length of storage on can vacuum, retention of volatiles in the grounds, and flavor acceptance of the brew, was investigated in vacuum-packed coffee that had been stored at −20° F. (−29° C.), 36–40° F. (2–4° C.), 68° F (20° C.), and 99° F. (37° C.), over a period of 27 months.

Loss of can vacuum with increasing temperature of storage and length of storage was observed during the first year. The same was true of volatiles remaining in the grounds.

A decrease in rate of loss of volatiles from the grounds was observed during the 6 to 27 months' period at all storage temperatures compared with the rate of loss during the first 6 months. This would seem to indicate that a state of equilibrium was being established between can vacuum and volatiles.

Flavor comparison of brews prepared from coffee stored at the several temperatures indicated that no significant change had occurred at any temperature. Statistical evaluation of flavor scores at 27 months by analysis of variance showed no significant variations due to temperature of storage.

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CHEMICAL EVALUATION OF THE PUNGENCY OF ONION AND GARLIC BY THE CONTENT OF VOLATILE REDUCING SUBSTANCES

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San Francisco, California

The volatile reducing substances (VRS) procedure has been applied to the evaluation of the strength or pungency of onion and garlic. The content of VRS gives a quantitative measure of the pungency of raw and dehydrated onion and garlic and enables the comparison of different samples of varying pungencies. Effects of such factors as aeration time, concentration of potassium permanganate oxidizing solution, boiling of extracts and of the presence of sulfur dioxide in samples on the recovery of VRS have been studied.

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EFFECT OF DIFFERENT SUGARS ON THE VISCOSITY AND GEL STRENGTH OF STARCH PASTES

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Effect of 10 different sugars and sirups on the viscosity and gel strength of 5% corn starch pastes was studied. Sugars and sirups were D-fructose, D-glucose, D-sorbitol, maltose, lactose, sucrose, invert sirup (50% invert), and 3 corn sirups unmixed (43, 56.3, and 63.7 D.E.). These were added in such amounts that the dry substance of the sweetening agent was equal to 5, 10, 20, 30, and 50% of the total water present.

With all sweetening agents used, there was a slight increase in the maximum hot-paste viscosity attained during gelatinization with increasing concentration of sugar up to 10% or 20%, followed by a decrease at hgher concentrations. There were small but consistent differences between the effects of the different sugars, especially between the monosaccharides and the disaccharides.

At the lowest concentration (5%), monosaccharides caused a very slight increase in gel strength, but concentrations of 20% or higher of all sugars used caused a decided decrease.

The effect of the various concentrations of sucrose on the gelatinization curves of waxy corn starch, a phosphate cross-linked waxy corn starch, and a thin-boiling (60-fluidity) corn starch was qualitatively the same as on ordinary corn starch. Higher concentrations of sucrose caused a decided decrease in the strength of the gels prepared from thin-boiling corn starch.

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DETECTION OF DROSOPHILA EGGS AND LARVAE IN TOMATO PRODUCTS

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and The Ohio State University
Columbus, Ohio

A study was made of the factors affecting the recovery of Drosophila fly eggs and larvae from tomato products. Several

parts of the AOAC procedure could be interpreted in various ways. Thereby, two analysts could obtain quite different results from the same sample. Refinements of the AOAC method were advanced in order to obtain more precise results. However, the AOAC method requires 1 to 2 hours to make a determination. A rapid reliable method would be desirable from the standpoint of the processor and analyst. A reliable method, examining the sample directly after filtering, under ultra-violet light with a cycloptic (3-dimensional) microscope, was developed.

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EFFECT OF LOW MOISTURE LEVELS ON THE THERMOSTABILITY OF ACTIVE DRY YEAST

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Commercial active dry yeast, which contains 8% moisture, is considered to have satisfactory stability qualities for most civilian uses. However, due to the special conditions likely to be encountered in the handling and storage of food supplies for the Armed Forces, it has been considered highly desirable to have an active dry yeast of improved stability for military uses.

Investigations have shown that as the moisture levels are reduced below 8% the yeast becomes increasingly stable. It is necessary, however, to rehydrate the yeast to approximately 8% moisture by moisture-vapor treatment prior to dispersing it in warm water in the manner regularly employed in making bread.

Results of investigations to determine (1) the improvement in thermostability which is conferred on yeast at low moisture levels, (2) methods of dehydration which can be used for reducing the moisture content to low levels, and (3) the feasibility of using moisture-vapor pretreatment for low moisture active dry yeast in the large-scale production of bread by a Military Mobile Bakery Company are reported.

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LINDANE RESIDUE CHANGES DURING FERMENTATION AND PROCESSING OF PICKLES

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An investigation was made of the lindane spray residue carry-through during the fermentation of cucumbers and the processing of pickles. Residues resulting from the spraying of harvested cucumbers and from field application of insect control schedules were evaluated. Amount of lindane was determined on the raw cucumbers, cured salt stock, and the resulting sour, sweet, and dill pickles. The Schechter-Hornstein colorimetric method for lindane was used.

Pickling cucumbers were found to contain 10 to 11 p.p.m. of lindane when sprayed (after harvest) with one pound of 25% lindane per 100 gallons, which produced from 2 to 4 p.p.m. in the pickles. Insect control schedules with 7 applications prior to harvest resulted in a lindane residue of about one p.p.m. on the cucumbers and the pickles contained less than 0.5 p.p.m. When lindane was added to the fermentation vats, at the rate of 10 p.p.m. (brine and cucumbers) the salt stock contained 7.3 p.p.m.; whereas an equal amount of inositol and lindane (10 p.p.m. each) resulted in 4.25 p.p.m. in the salt stock and the pickles contained 7 and 3 p.p.m., respectively.

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PENETRATION AND GROWTH OF Ps. FLUORESCENS IN CHICKEN EGGS

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Effects of various egg shell treatments and characteristics on the penetration and growth of *Ps. fluorescens* were investigated. A standard infection technique was used to inoculate the eggs. Contamination was measured by the appearance of fluorescent albumen when the egg was held under an ultraviolet candler.

Results from this study indicate that no significant differences exist in the incidence of infection of eggs of different porosities classified by either the 14-day weight loss or dye porosity method.

Old eggs tended to become infected more easily than fresh ones. Eggs held at 97° F. for 2 weeks had a greater incidence of infection than those held one week. Those held one week had a greater incidence of infection than fresh eggs.

Washing of eggs in water of 120° F. with and without detergent solutions increased the incidence of *Pseudomonas* infection.

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USE OF THE AUTOMATIC GREEN ROT DETECTOR TO IMPROVE THE QUALITY OF LIQUID EGG

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Effect of automatically removing green rot fluorescent shell eggs from "breaking stocks" on the bacteriological condition of the resulting liquid egg products was studied. A comparison of standard plate counts made on these products (albumen, yolk, and mix) was compared to those made on similar products prepared without the use of the green rot detector, and with those made on products prepared with the aid of this device but without organoleptic examination.

It was found that when the green rot detector was used as a supplement to organoleptic examination, the bacterial counts of all the liquid egg products were significantly lower than when organoleptic examination alone was made. The detector when used without subsequent organoleptic examination, showed a slight, although not significant, tendency to be more effective in reducing bacterial counts than organoleptic examination alone. The study was repeated in the summer season, when incidence of rots tends to be high. The combination of automatic green rot detection and organoleptic examination again resulted in significantly lower bacterial counts of the liquid egg products, although the effect was not as marked as in the spring trials. This indicated that sources of contamination other than green rots are of greater importance in the warmer season.

Examination of the machine rejected eggs when broken out under a "black-light" revealed that the incidence of green rots in the lots of eggs used for these studies was quite low (0.3%). It was concluded that very few green rots per case of eggs may suffice to markedly increase the bacterial counts of liquid egg products, thus emphasizing the value of removing such eggs from breaking stocks.

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STUDIES ON THE EFFECT OF A CHLORTETRACYCLINE TREATMENT ON THE GREEN-ROT SPOILAGE OF EGGS

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Standard Assay procedures appear to be inadequate in quantitatively determining the amount of total antibiotic in whole and unadulterated egg albumen. However, preliminary investigations have indicated that at least 80% of added antibiotic activity can be reclaimed when albumen containing antibiotics of the tetracycline group are diluted 1:3. In the determination of the effect of chlortetracycline (CTC) treatment of eggs on the incidence of "green-rot" spoilage, the questions arose as to the actual or potential activity of the masked portion of the antibiotic against infecting microorganisms. Consequently, a method was devised whereby this activity could be quantitatively estimated. Eggs of known porosity were selected in pairs from individual hens. One egg of each pair was evacuated and the contents replaced with an equal volume of sterile saline. The shell opening was then sealed. The other member of the pair was left intact. Each pair was then immersed for 10 minutes in dip solutions of varying CTC concentration. Dip solutions and egg temperatures were 7–9° C. and 30° C., respectively. Results of assays of saline contents and albumen were compared. Theoretically, the difference in CTC concentration of the saline component of one egg in the pair and in the albumen of the other should constitute the concentration of albumen-bound antibiotic. Results obtained indicate that up to 50% more antibiotic could be assayed in the saline than in the albumen. Results further indicate that substantial portions of antibiotic can be recovered in the various components of the egg forecasting the possibilities of the antibiotic dip process as a method of preventing bacterial spoilage of eggs. Preliminary experiments have been performed wherein market eggs, after antibiotic treatment and subsequent storage for various periods under commercial conditions, were examined under black light to determine treatment effects on incidence of "green-rot" spoilage. Results of these studies will be reported.

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STUDIES ON MICROBIOLOGICAL METHODS FOR PREDICTING SHELF LIFE OF DRESSED POULTRY

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A color test dependent upon the reduction of a nutrient medium was used. The medium was designed to allow rapid growth of psychrophilic bacteria but to suppress the growth of mesophilic bacteria. The medium was incubated at 20° C. for a maximum period of 48 hours. The test was designed for plant use so that the need of better handling and sanitation can be determined in 24 to 48 hours after processing of the poultry.

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CORRELATION BETWEEN FLAVOR AND NUMBER OF MICROORGANISMS DURING STORAGE OF FRESH, CUT-UP BROILERS

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Studies by a number of investigators have shown that certain antibiotics will markedly retard development of bacteria and fungi and thus prolong the storage life of the product. Any increase in the time that meat is stored raises the question of the effect of this treatment on the organoleptic qualities of the food. Thus, this investigation was conducted to determine whether or not there was a correlation between the flavor and the number of microorganisms that occurred on untreated control or on antibiotic-treated, fresh, cut-up broilers stored in a commercial refrigerated display case.

Untreated control and antibiotic-treated whole birds were stored for various periods of time in crushed ice until removal for cutting, packaging, and storing in the refrigerated case for 24 to 72 hours. Comparisons were made between different types of packaging material; a vacuum-type package was included in the study. Bacterial counts were made initially and during storage. A taste panel evaluated the quality of the broilers. The data obtained will be presented and discussed.

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EFFECT OF SEX, AGE AND HORMONIZATION ON CHEMICAL COMPOSITION OF CHICKEN MEAT

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Use of estrogen-like hormones for improving broiler finish is increasing. These experiments were designed to investigate the effects of sex, age, and hormonization on certain chemical constituents of meat. Diethylstilbestrol paste was used for hormonizing chickens which were slaughtered at 6, 10, and 14 weeks of age.

Using A.O.A.C. methods for determining percent moisture, crude protein, and ether extract, it was found that age and hormonization significantly affected the measured variables. These analyses were made on light and dark meat, roasted and uncooked. The effect of sex on the measured variables was not significant. Percent moisture decreased with age and percent fat increased with age. Hormonization significantly increased fat content.

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ORGANOLEPTIC EVALUATION OF BROILERS FED MILK PRODUCT SUPPLEMENTS

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During the past 11 months a total of 1910 tests were performed by trained tasters to differentiate between poultry fed milk products and those receiving no milk products. The selection and training of the panel members, the cookery involved, and the analysis of the data obtained are discussed in detail.

A method was designed to extract flavor from chickens gently, by preparing a simple broth of chicken, salt, and water. No other seasoning was used. This broth, along with corresponding chicken meat, was served to a panel of traned tasters, carefully chosen for their discriminating ability.

A numerical scoring device was designed to evaluate properly any differences found in the poultry. These score sheets were subjected to statistical evaluation and an interpretation of these results is presented.

Results of these tests indicate that the eating quality of poultry is improved when the basal ration is supplemented with a milk product. Suggestions are offered to explain this result.

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TWO METHODS FOR PALATABILITY EVALUATION OF CHICKENS FED VARIOUS EXPERIMENTAL DIETS

PART I

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PART II

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Flavor of chickens raised at the University of Connecticut on diets containing fish oils or tallow was evaluated by taste panels at the University of Connecticut and at the U. S. Department of Agriculture. In one experiment, chickens were raised on a 25% protein basal ration to 8 weeks of age, with the following added variables: 0, ½, 1, or 2% menhaden oil, with and without 0.0125% DPPD; or ½, 1, or 2% tallow. In a second experiment, menhaden oil and red fish oil were fed for 7 weeks at the 1 and 2% levels, and tallow at the 2% level. A finishing ration, in which corn replaced fish oil, was fed for an additional three weeks.

Two methods were employed for palatability evaluation of the chickens from the first experiment. One-half of each chicken was rated at each of the 2 locations. At the USDA laboratory, samples oven-broiled by standard procedures at 2 temperatures, 325° and 400° F., were rated by a panel of 4 experienced judges in 16 judging sessions under controlled conditions. At the University of Connecticut, each of 200 volunteer participants was given 3 half-birds to be cooked simultaneously in separate utensils using a family recipe. Flavor, aroma, and tenderness of the chickens were rated by the University group; flavor, moistness, and tenderness were evaluated by the USDA panel.

The two taste-testing methods produced essentially the same results: Additions of ½, 1, or 2% tallow or ½% menhaden oil did not cause objectionable off-flavors. One or 2% menhaden oil caused fishy off-flavors which were slightly less noticeable in birds fed DPPD. The USDA panel found no statistically significant difference in tenderness; University results indicated a preference for chickens fed added fat where off-flavor was not apparent.

In the sevond experiment carried out only at the University, it was found that finisher rations did not eliminate off-flavors in birds fed menhaden oil in the starter, but did mask fishy characteristics. Two percent red fish oil did not cause fishy off-flavors, but resulted in an unchickenlike flavor, which was eliminated in birds fed the finisher.

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EXPERIMENTAL MICROWAVE ENERGY PROCEDURES IN FOOD PRESERVATION

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Microwave energy has recently been successfully used in food preservation procedures. Experiments carried out at 2450 mc. with an average power input to the load of about 100 w. have yielded information on the ability of this form of energy to change the concentration of tissue constituents and effect the preservation of the product.

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EFFECT OF COMBINED HEAT AND RADIATION TREATMENTS ON BACTERIAL SPORES

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When pure cultures of spores of *Bacillus cereus* and Cameron's Putrefactive Anaerobe No. 3679 were irradiated with gamma rays, then suspended in water ,and heated in a special apparatus for determining heat resistance of spors, it was found that increasing doses of gamma radiation resulted in increased sensitivity to heat. Destruction of 90% and 95% of a culture of P. A. 3679 spores by heating did not affect the radiosensitivity of the remaining spores when they were subsequently irradiated. Irradiation of P. A. 3679 spores in a ham medium of 3.5% solids resulted in a somewhat reduced effect of radiation on the thermal resistance. It was also shown that the heat sensitivity of spores

of P. A. 3679 mixed into a ham puree was increased by prior gamma irradiation. Theoretical aspects of these phenomena are discussed.

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EFFECT OF GAMMA RADIATION ON BACTERIAL SPORES WHICH HAVE UNDERGONE ACCELERATED GERMINATION INDUCED BY TREATMENT WITH L-AMINO ACIDS

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Conditions were established for the induction of accelerated germination of spores of Cameron's Putrefactive Anaerobe No. 3679 and *Bacillus cereus* var. *terminalis*. Sodium thioglycollate, used in the anaerobic germination treatment, was found to protect P. A. No. 3679 spores against radiation inactivation. *B. cereus* spores were found to become more sensitive to irradiation when treated with L-alanine and adenosine as well as with adenosine alone.

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USE OF HIGH-VOLTAGE CATHODE RAYS TO DESTROY BACTERIA OF THE SALMONELLA GROUP IN WHOLE EGG SOLIDS, EGG YOLK SOLIDS, AND FROZEN EGG YOLK

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Doses of high-voltage cathode rays required to bring about a 10^7-fold reduction in the numbers of *Salmonella* in whole egg solids, egg yolk solids, and frozen egg yolk have been determined. Evidence that various atmospheres did not appreciably affect these dose requirements has been obtained. The doses of cathode rays necessary for the total destruction of the natural flora of these products were also determined. Effect of high-voltage cathode rays on the chemical, organoleptic, and functional properties of these egg products, and possible methods of alleviating any off-flavor conditions caused by irradiation treatment were investigated.

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ULTRAVIOLET IRRADIATION OF EGG WHITE: SALMONELLA DESTRUCTION AND FUNCTIONAL PROPERTY EFFECTS

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The centrifugal filmer developed at the Michael Reese Research Foundation for the ultraviolet irradiation of blood serum and polio vaccine has been tested for its applicability in the elimination of *Salmonella* from liquid egg white. The numbers of *Salmonella* organisms in egg white can be reduced significantly at doses of ultraviolet irradiation which do not appreciably alter volumes of angel food cakes prepared from irradiated egg white. Flavor is not seriously affected and off-odors formed during irradiation are largely volatile. This treatment offers some promise as a practical *Salmonella* control measure.

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RADIATION STERILIZATION OF APPLE SLICES

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This investigation was initiated to determine the effect of maturity, ripeness, preparatory treatment and storage on apple slices (Jonathan) subjected to ionizing radiation.

Results of organoleptic evaluation indicated that the best over-all procedure was to use mature apples, process immediately after harvest, blanch in dilute sugar solution, vacuum pack, freeze and irradiate at 0.5 megarep. Under these conditions the apple slices were still acceptable after 6 months' storage at 75° F.

When evaluation was carried out on pies made with irradiated slices and the usual spices, the effect of the radiation treatment was less marked than when slices alone were judged. There was no advantage in preparing the apple slices in the form of pie fillings with spices and pectin before the radiation sterilization.

The radation dose necessary to control spoilage in cans heavily inoculated with various yeasts ranged from 0.5 to 1.5 megarep.

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THE LEVEL OF IRRADIATION AT WHICH TASTE CHANGE IS NOTED IN BREAD MADE FROM IRRADIATED FLOUR AND IRRADIATED WHEAT AS DEDUCED FROM TASTE PANEL RESULTS

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Bread made from irradiated flour and flour milled from irradiated wheat were studied to determine the level of irradiation that would produce distinguishable taste and/or odor changes. Results were analyzed by probit analysis to determine the level of irradiation at which half the judgments (above chance) of the taste panel as to the odd sample in a triangle test were correct. The level in question was found to be at about 50,000 rep in each case.

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EFFECT OF IONIZING RADIATIONS ON SOUTHERN OYSTERS

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Oysters were subjected to several levels of gamma irradiation and stored under various conditions. Changes which occurred during irradiation and subsequent storage were noted and attempts were made to eliminate undesirable side effects.

Irradiation of raw oysters with doses up to 3.5×10^6 rep produced an off odor described as "grassy". Neither free sulfhydryl groups nor catalase activity was noticeably reduced. Subsequent souring and fall in pH occurred both in irradiated and in unirradiated controls, indicating that this type of spoilage is probably caused by enzymes within the oyster rather than by bacteria. The irradiation of cooked oysters produced a somewhat different type of off odor, described as *oxidized*. The off odors were not eliminated by the addition of various antioxidants and free radical acceptors.

The most acceptable irradiated products after brief storage periods were those irradiated raw and subsequently heated sufficiently to destroy enzymes. The heating not only eliminated the grassy odor but also prevented subsequent enzymatic souring.

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STUDIES ON CHERRY SCALD. I. RELATIONSHIP BETWEEN BRUISING AND RESPIRATION IN WATER

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Scald which occurs in lug-hauled cherries and also during transportation and storage of cherries in water is a serious problem in the cherry industry. The respiration of bruised and unbruised Montmorency cherries in water at 10° and 30° C. was studied to determine the rate of respiration, and the oxygen level at which scald occurs. The residual oxygen content of the water was measured throughout the respiratory period by a modified polarographic technique.

It was found that bruising and/or higher temperature increased the oxygen uptake of the cherries. Extensive bruising resulted in a 5-fold increase in oxygen uptake at 10° and in a 2-fold increase at 30° C. Both unbruised and bruised fruit showed a marked increase in oxygen uptake when the temperature was raised from 10° to 30° C.

Results of this study indicate that unbruised cherries are resistant to scald when immersed in water at 10° C. Bruised cherries are susceptible to scald when immersed in water at 10° C. unless the oxygen level of the water is maintained above 3 p.p.m. At higher temperatures bruised cherries may scald even at high levels of dissolved oxygen. In commercial practice, therefore, it is important to maintain low temperatures as well as adequate dissolved oxygen levels in soaking tanks and tank trucks to avoid scald.

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STUDIES ON CHERRY SCALD. II. RELATIONSHIP BETWEEN BRUISING AND RESPIRATION IN AIR

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Eastern Utilization Research Branch, Agricultural Research Service, U. S. Department of Agriculture
Philadelphia, Pennsylvania

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Oxygen uptake and carbon dioxide output of unbruised and bruised Montmorency cherries were determined at 10° and 30° C. in air using a modified Warburg technique. Rates for both oxygen and carbon dioxide increased about 2 to 3 fold with a 20° C. rise in temperature. Bruising caused an increase in respiration, especially carbon dioxide output, and a shift in the respiratory quotient. Oxygen uptake was about 50 times as rapid in air as in water.

Cherries scald in air under conditions of bruising and warm temperatures (25° to 30° C.). Cherries in lugs scald at the points of contact with the container or with other cherries. Thus, lug scald appears to be similar to tank scald since both occur under conditions of restricted respiration.

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CAUSES OF SCALD IN RED TART CHERRIES

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Occurrence of scald during the processing of red tart cherries has been a vexing problem to processors during the last decade. Since this problem is apparently becoming more serious, an investigation of the factors which cause scald has been carried out in New York State during the past several seasons.

Scald in red tart cherries is defined here as the diffusion of red pigment from the skin into the yellow flesh beneath, leaving a bleached spot on the skin. The oxidative browning of the affected tissue which often follows is considered as a separate mechanism and may occur independently. It was observed that "lug scald" and "tank scald" differ only in configuration, or area affected.

It has been found that scald is invariably triggered by bruising. This is apparently the prime cause of both scald and oxidation. Unbruised cherries may be held warm in air or water without scalding. Once the cherries are bruised, the extent to which scald and oxidation develop is dependent on the ambient temperature and on the elapsed time after bruising. In addition, it was observed that scald develops at an appreciable rate only where the surface of the cherry is wet. Cherries, bruised but kept dry, may be held in warm air without scalding, but not without browning of the bruised flesh under the skin.

Control of scald is directed towards reducing the over-all severity of the factors affecting scald, both in the orchard and in the processing plant. The fruit is chilled to prevent deterioration while it is held to promote firming. The extent of this holding period must be modified according to the damage, delay, and exposure to summer heat which has occurred in the orchard. Fruit which has been mishandled before reaching the processor must be processed promptly to minimize scald damage. On the other hand, careful handling and prompt cooling will permit longer holding periods in the plant without excessive scald and oxidation.

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CONSUMER PREFERENCE STUDIES ON APPLE SAUCE: SUGAR-ACID RELATIONS

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A survey of commercial apple sauce samples showed a wide range of sugar and acid content and no significant correlation between the two. Samples of varying sugar and acid content were prepared from a typical commercial sauce by the addition of sugar and citric acid. These samples were presented to a consumer-type panel of 100 members for evaluation, using a ranking method. Preference was shown for a sugar-acid ratio of about 45 to 1.

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FACTORS INFLUENCING DRAINED WEIGHT OF CANNED CLING PEACHES

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Drained weight and Brix readings are important factors in grading canned cling peaches. Immediately after the peaches are canned, the drained weight falls below the filling weight because fluid from peach tissue is lost to the sugar syrup as a result of osmosis. On storage, the weight of peach tissue increases again because of penetration of sugar into the fruit.

Drained weight decreased with increase in concentration of the ingoing sucrose syrup. Equilibrium Brix readings increased with increase in concentration of the ingoing syrup. For dietetic canned peaches which were canned in plain water, the drained weight was higher than for those canned in sucrose syrup. The influence of fill weight, maturity of fruit, concentration of ingoing sucrose syrup, and storage time on drained weight and on Brix reading of canned cling peaches is presented.

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PENETRATION OF MALTOSACCHARIDES IN PROCESSED CLINGSTONE PEACHES

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Sugar penetration into canned clingstone peaches was investigated using C^{14} labeled starch hydrolysis products of the amylose series.

Small amounts of the C^{14} labeled sugars ranging in size from glucose to maltohexose were added to a normal cover syrup in which the clingstone peaches were canned. Normal canning procedures were followed.

The penetration of the individual sugar into the processed peaches was studied by the use of histological and radiochemical techniques.

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RELATION OF ACIDITY TO VARIATION IN BROWNING OF CANNED GRAPEFRUIT SECTIONS DURING STORAGE

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Purpose of this investigation was to determine the relation between some of the chemical or physical properties of canned grapefruit sections and the can to can variation in darkening or browning which occurs in packs of this product after long periods of storage under usual commercial conditions. The color, total acidity, soluble solids (° Brix), Brix/acid ratio, pH, ascorbic acid, drained weight, headspace and vacuum were determined for many individual cans of grapefruit sections from several commercial packs. Cans of sections obtained from a commercial plant every 2 weeks throughout a packing season were examined after being stored for 6 months at 90° F.; also examined were cans of 2 packs that had been stored in a commercial warehouse in Florida for 10 and 14 months, respectively. Commercially packed samples, in which the acid level was adjusted by the addition of small amounts of citric acid or sodium hydroxide, were also stored at 90° F. for 6 months and then checked.

Results indicated that the darkening of canned grapefruit sections during storage occurred more frequently in those sections having a high acidity and low pH. Samples with a high Brix/acid ratio did not darken as much as those with a low ratio; however, at a given ratio, the samples with the lower acidity and lower soluble solids were better in color. Overpacking of cans gave high drained weights, low vacuum, low headspace and resulted in a high acid level and poor color. The degree of browning that occurred during storage of canned grapefruit sections did not correlate with the ascorbic acid content of the products.

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RAPID ESTIMATION OF THE BACTERIAL CONTENT OF PRECOOKED FROZEN FOODS

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A rapid resazurin reduction method has been developed which permits estimation of the numbers of bacteria in precooked frozen foods (opultry and meat pies) within 2 to 8 hours. The methodology finally adopted and recommended is the result of a detailed investigation of various oxidation-reduction indicators including methylene blue, resazurin, and tetrazolium compounds. The composition and pH of different nutrient media as substrates, incubation temperature, size of sample, and other factors were also investigated. In the test, aliquots of sample and medium are mixed with resazurin and incubated. The time required for the mixture to change from blue to colorless is recorded.

A comparative analysis was made of approximately 60 poultry and meat pies in which both the indicator reduction time and the plate count for each pie were determined. On the basis of these data, it was possible to subdivide the pies into several distinct groups which covered a range from less than 35,000 to more than 9,000,000 bacteria per gram. The degree of predictability of bacterial numbers from indicator reduction times was high. This and other aspects will be discussed.

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A SURVEY OF THE BACTERIOLOGICAL QUALITY OF FROZEN POULTRY PIES AS OBTAINED ON A LOCAL RETAIL MARKET

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Frozen poultry pies, as obtained in local supermarkets, were evaluated for their bacteriological quality. Samples of 5 brands were periodically examined in order to obtain samples from different manufacturing lots. In addition to the standard plate count and the coliform plate count, determinations were also made for the presence of enterococci, coagulase—positive *Staphylococci* and *Salmonella*. Tests were made on: (1) frozen pies, (2) pies that had been baked in an oven in which the temperature was maintained at the desired level with the aid of a recording potentiometer, and (3) pies that were baked under conditions duplicating those that may be found in the ordinary family kitchen. The pies were baked according to the manufacturers directions. Determinations on the unbaked pies indicated large differences in the bacterial contamination of the several brands.

Determinations on the baked pies indicated that some of the times and temperatures recommended by the manufacturers were not sufficient to eliminate the non-spore forming organisms. When the pies were baked under home conditions, the center of the pies did not reach a high enough temperature to satisfactorily reduce the bacterial count. Coliforms as well as the other non-spore formers tested for were detected in the baked pies.

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PRESERVATION OF APPLE CIDER WITH SODIUM SORBATE

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Apple cider (freshly pressed apple juice) retains a fresh, unfermented flavor for about one day at 70° F. and about one week under refrigeration. Treatments which could extend the storage life of fresh cider and not change the flavor or appearance would be highly desirable.

Sodium sorbate (0.1%) extended the storage life of fresh cider from one day to 7 days at 70° F. and from one week to several months at a storage temperature of 40° F. Sodium sorbate inhibited yeasts and molds but did not control bacteria. Bacterial growth was inhibited by lowering the storage temperature, by adding traces of bisulfite, or by mild heat (130 to 140° F.).

Sodium sorbate solution was easier to use with apple cider than was powdered sorbic acid because of the low solubility of the latter in cider. Sodium sorbate was more effective in preserving fresh cider than was sodium benzoate and imparted no detectable off-flavor when used in concentrations of 0.1% or less.

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SOME FACTORS INFLUENCING THERMAL DEATH TIME RESULTS OBTAINED BY THE THERMO-RESISTOMETER METHOD

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Results of a series of experiments concerned with discrepancies in thermal death time data are reported.

In these experiments, strained peas and phosphate buffer of variable ionic concentration were used as suspending media for the Putrefactive Anaerobe No. 3679 when subjecting it to temperatures in the range 240° F. (116° C.) to 290° F. (143° C.), inclusive.

Reasons for certain discrepancies are discussed in the light of results obtained.

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STERILIZATION BY MEANS OF SPORE DEACTIVATION

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Spore deactivation is defined as the loss of ability of a spore to develop under favorable growth conditions when stored under conditions preventing development. Spores of 4 strains of obligatory thermophilic members of the genus Bacillus deactivate in suitable growth media at storage temperatures below the minimum growth temperature. The rate at which deactivation takes place is a function of the temperature of storage in the region 70-98° F. Deactivation occurs both with mildly heated spores and with the survivors of high temperature processing. Deactivation of mildly heated spores of a mesophilic bacillus suspended in distilled water is also a function of temperature in the region 50-70° F. Sterilization by means of spore deactivation occurs when the original spore load per unit sample has deactivated to some pre-specified low level such as one spore per 1000 unit samples. Sterilization by means of spore deactivation is a function of the initial load of spores at the time of starting deactivation and the temperature of storage. The implications for commercial processing are discussed.

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A COMPARATIVE EVALUATION OF METHODS FOR DETERMINING THE BACTERIAL CONTAMINATION OF SURFACES

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Presently available techniques commonly employed for measuring bacterial contamination on food processing equipment and utensils do not yield quantitative recoveries and are subject to inherent errors which affect their reliability. Because of these limitations, an evaluation of several methods has been undertaken to determine their accuracy, reproducibility, and practicality under field conditions. The methods studied were (a) cotton swab; (b) alginate swab; (c) contact agar aluminum dish; (d) contact agar syringe; (e) Petri dish dinner plate combination; (f) surface rinse-agar plate count; (g) surface rinse-membrane filter count. Aliquots of aqueous or milk suspensions of *Micrococcus pyogenes* var. *aureus* and *Bacillus globigii* spores were evenly distributed over china surfaces and permitted to dry under standardized conditions of temperature and relative humidity. The percentage of the total contamination that each of the methods detected was determined by comparing their recoveries to that of the direct surface agar plate method, a laboratory technique developed by the authors, which determines 90% to 100% of the viable bacterial contaminants on nonporous surfaces under controlled environmental conditions.

Under the experimental conditions employed, rinsing technique, such as the surface rinse-agar plate count or surface rinse-membrane filter count, yields good quantitation and detects between 30% to 60% more of the contamination than do the cotton and alginate swab methods or contact agar techniques. The contact agar syringe method was found to be as efficient as the cotton swab technique, but was subject to less error and easier to use.

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THE SALARY AND PROFESSIONAL PICTURE OF THE FOOD TECHNOLOGIST IN 1957

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Results of the Institute of Food Technologists salary and professional status survey will be presented. Data will be given on effects of geographical location, years of experience, field of food technology, phase of food technology and certain other factors. Results of the survey of food technologists will be compared with recent American Chemical Society survey and other available professional society surveys.

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THE TIME HAS COME

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In recent years, a number of scientific societies have given serious consideration to, and taken subsequent positive action concerning, the professional status of their members. This has resulted in management's awareness of inequities in classifications of scientists, promotions, salary scales, utilization of scientific talent, human relations, plant education, permanency of position, retirement benefits, over-age employment, etc. Many companies have acted on these matters to the satisfaction of their employees and to their own personal advantage. It is believed the Institute of Food Technologists has developed sufficient prestige and grown sufficiently large to consider raising the status of food technologists as an integral function of their program. It is suggested that a National Committee be appointed for this purpose to initiate thinking and to stimulate action through our National Office. Examples will be given relative to certain scientific societies which now have such a program in progress and the results which have been obtained.

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THE PROFESSIONAL SOCIETY AS A "PRO" MAKER

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The Royal Institute of Chemistry's membership system has helped raise the professional status of chemists in Great Britain. This system and its influences will be discussed.

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ADDITIVES NEEDED FOR FOOD TECHNOLOGISTS

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Additives have improved the quality and attractiveness of foods. It will be pointed out that certain additives are needed to make the food technology profession more attractive and to maintain a high standard of quality in the people entering this profession.

The problem that must be overcome is the lack of knowledge among high school students and even high school science teachers that a profession such as Food Technology exists. Most everyone has heard of engineers, chemists, and bacteriologists but food technology is an unknown. This situation must be corrected at the high school level.

Several approaches will be suggested that are aimed at informing the high school student, the parents, and the public in general about the profession of food technologist. The role that IFT, industry, and educational institutions can play will be outlined.

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TOWARDS A MORE UNIFORM PROFESSIONAL TRAINING FOR FOOD TECHNOLOGISTS

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Deliberations of the IFT Committee on Education, Sub-committee on Accreditation, are reported. The subject of accreditation will be analyzed in considerable detail. A proposed curriculum will be presented containing the scientific subjects deemed necessary for the mastery of the kind of technical knowledge that would produce a true scientist. The proposed curriculum, the result of deliberations of the sub-committee (Lee J. Kenyon, Chairman, C. Olin Ball, and Frank K. Lawler), reflects consultation with many people, inside and outside the teaching profession, who have given the matter of the collegiate training of Food Technologists serious thought.

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APPLICATION OF THE OXIDATION REDUCTION CONCEPT TO FOOD PROBLEMS

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Methods of determination and adequacy of various oxidation reduction indices for foods and food ingredients are discussed. A new method for evaluation of a reproducible significant oxidation reduction index is presented, which is based on multiple electrode measurements of potentials due to interaction between the investigated material and a reversible dye. The applicability of this index to oxidation reduction investigatons of food materals is considered.

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ANTIOXIDANT IN MALT AND MALT SPROUTS

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Experimental evidence is presented to show that malt flours serve as antioxidants for edible oils. Five to 10% of malt flours when added to corn oil inhibited the accumulation of peroxides upon aeration or oxygenation. Flours from distillers, brewers, caramel malts, and malt "sprouts" showed decreasing order of antioxidant activity. The antioxidant of malt sprouts could be concentrated by methanol extraction of sprouts which dissolved 10% to 15% of the source material. At 0.01% concentration, such extracts were comparable to a BHA-BHT commercial antioxidant mixture for inhibiting peroxide accumulation upon oxygenation of corn oil at 100° C. Preliminary trials suggest usefulness of the natural wholesome malt flours in stabilizing flavor of food products prepared in or with oil. Particularly advantageous in the use of this inherently safe, nutritious substance as an antioxidant is that by selection of appropriate malt type, flavoring, enzymatic, or coloring, values of the degree desired can be simultaneously achieved.

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TRIHYDROXY BUTYROPHENONE—A FOOD GRADE ANTIOXIDANT

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The physical and chemical properties of a new food approved antioxidant are described. The activity of this butylated phenol in various fats, oils and polymers is shown. Suggestions are also made for practical application and data is shown of its effectiveness.

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BROWNING OF SUGAR SOLUTIONS. I. EFFECT OF pH AND TYPE OF AMINO ACID

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The color (browning) of maple sirup is developed during the atmospheric boiling process used to concentrate the maple sap to sirup. Previous studies have shown that this browning is associated with the reducing sugars and perhaps the amino acids of the sap. Therefore, model experiments have been conducted to gain information regarding the origin, mechanism of formation, and chemical composition of the color bodies formed in dilute glucose solutions under varied conditions. The present paper reports the result obtained from a statistically designed and evaluated study on the effect of the presence of different amino acids, selected to represent acidic (glutamic), neutral (alanine), and basic (lysine) amino acids in dilute glucose solutions heated at an elevated temperature. The reactions were studied under acidic, basic, and neutral conditions. The amount of browning was measured spectrophotometrically. Only lysine, the basic amino acid, caused a significant increase in the amount of browning and this occurred only at the alkaline pH's. Further, lysine was the only amino acid of this representative group which caused even slight browning at pH's below 7. From these studies, it is concluded that an alkaline condition is a prerequisite for the browning of dilute glucose solutions, with or without an amino acid.

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BROWNING OF SUGAR SOLUTIONS. II. EFFECT OF THE POSITION OF THE AMINO GROUP IN THE AMINO ACID

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Presence of a basic amino acid (lysine) in a glucose solution at a pH of 7 or higher caused a significant increase in the color developed upon heating the sugar solution (see first paper, this series). The acidic and neutral amino acids had no significant effect, nor did histidine and arginine, other basic amino acids. Therefore, a series of aliphatic amino acids having 3, 4, 5 and 6 carbon atoms in the chain were tested as to the effect of the position of the amino group or groups in the molecule upon the amount of color (browning) produced in a glucose solution. The reactions between these acids and glucose were conducted at elevated temperature under alkaline conditions where a significant amount of color is produced in a solution containing only glucose. The acids with an amino group in the alpha position had almost no effect on the amount of color produced. The acids with the amino group at the end of the chain caused a decided increase in color formation. However, this was influenced both positively and negatively by the chain length of the acid. The diamino acids, in general, produced even greater increases in color with largest increases produced with the longer chain length.

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RELATIONSHIP BETWEEN THE TYPE AND ORIGIN OF REDUCING SUGARS IN SAP AND THE COLOR AND FLAVOR OF MAPLE SIRUP

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Maple sirup made from early, cold weather sap flows or from sterile sap has a light amber color and a delicate maple flavor. Sirup made in the late season or from non-sterile sap usually possesses a flavor denoted as caramel and also has a dark amber or brown color which decrease the value of the sirup. Analyses of sirups showed that with increasing coloration and caramel flavor there was also an increase in concentration of reducing sugar.

This paper is a report of studies to determine the effect of the type and origin of reducing sugars in sap on the formation of color and caramel flavor in maple sirup.

It has been shown that fresh maple sap contains no hexose sugars but that they arise as a result of microbial fermentation. To ascertain the specificity of the sugars involved in color and flavor formation, crystalline glucose, fructose, and maltose and reducing sugars derived from disaccharides by enzymic and ion exchange resin hydrolysis were added to sterile sap prior to its concentration to sirup by boiling. The disaccharides sucrose and maltose were used since they yield hexoses of furanose and pyranose forms. The sirups made from the treated sap were evaluated for maple and caramel flavor and analyzed for color and invert sugar. Correlations were made between the percentage of invert sugar, source and form of hexose sugars, and the color and caramel flavor of the sirups.

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TIME-TEMPERATURE TOLERANCE OF FROZEN FOODS. I. PURPOSE AND SIGNIFICANCE OF THE INVESTIGATION

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A comprehensive time-temperature tolerance investigation was initiated several years ago in the Western Utilization Research Branch, when it became apparent that in many cases frozen foods were badly deteriorated in appearance, eating quality, and nutritive value as they reached the consumer. Research workers had shown that these products maintain good quality for a long time at 0° F., but knowledge of the rates of deterioration at higher temperatures was incomplete and inconclusive. Facts were needed on quality stability under as wide a range of conditions as the products might experience, in order to afford a rational basis for improvement of conditions and practices. Adequate test facilities were installed by the Western Utilization Research Branch. Comprehensive tests of frozen fruits, vegetables, poultry products, and precooked frozen foods were initiated. Results of several phases have now been published in *Food Technology* and elsewhere. Other publications will follow. Sum of these contributions will be a complete treatise on frozen food technology.

The results on a number of commercially packed products establish (a) rates of change in quality factors, measured both subjectively and objectively, at temperatures ranging from —30° to +40° F., (b) the extent of change during time and temperature experiences simulating distribution conditions, (c) the criteria for several objective tests that reflect severity of adverse experiences a product has undergone; and (d) in some cases, means for increasing resistance of products to unavoidable rises in temperature. The work has a significant bearing on all factors in the frozen food industry because it will supply a basis for improvement of practices and thus assure continued healthy growth of the industry.

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TIME-TEMPERATURE TOLERANCE OF FROZEN FOODS. II. STRAWBERRIES AND OTHER FROZEN FRUITS IN RETAIL PACKAGES

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Commercially packed frozen fruits in retail packages have been studied over a 5-year period. Approximately 25,000 packages of strawberries, peaches, raspberries, and cherries were obtained from important producing areas and subjected to a wide variety of time-temperature conditions. These included steady temperatures, regularly fluctuating temperatures, and various time-temperature patterns designed to simulate conditions encountered during transportation and distribution of frozen foods. At 0° F. or lower, all fruits studied maintained their appearance and organoleptic qualities very well for one year or longer. The rates of color, flavor, and ascorbic acid changes in frozen strawberries varied exponentially with temperature. Each 5° F. rise in temperature caused a 2- to 3-fold increase in rate of color and flavor deterioration. Over 90% of the strawberry and peach samples studied became significantly different from their controls with respect to color or flavor after one to 2 weeks of storage at 20° F. Raspberries and red sour cherries were somewhat more stable than peaches and strawberries when held at temperatures above 0° F.

Fluctuating temperatures did not cause adverse effects in any of the fruits studied other than those expected at equivalent steady temperatures. At 0° F. or lower, packaging was not a major factor in determining storage life, but above this temperature, hermetic containers were superior to non-hermetic packages with respect to color, flavor, and ascorbic acid retention. Every adverse time-temperature experience subtracts something from the original fresh quality of these fruit products. Relatively brief exposures to temperatures well short of defrosting will add their effects and produce substantial damage.

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TIME-TEMPERATURE TOLERANCE OF FROZEN FOODS. III. GREEN PEAS AND SNAP BEANS IN RETAIL PACKAGES

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Investigations were directed toward the time and temperature requirements necessary for the maintenance of quality in frozen peas and green beans during storage, transportation, and market distribution. Ten to 15 temperature levels, constant and fluctuating, were tested within the range —10° F. to 40° F. Cumulative effects at two or more temperatures were determined. Package variation in viable bacterial count and trends of change during storage were investigated. Five tests were used throughout the study to record quality deterioration: (a) changes in flavor and (b) color as measured by a panel of judges, (c) changes in color attributes as measured objectively by the Hunter Color-Difference Meter, (d) loss of reduced ascorbic acid, and (e) loss of chlorophyll measured as percentage conversion to pheophytin. Preliminary correlation factors for comparing time required for first detectable flavor and visual color changes with accompanying physical and chemical change have been calculated. Some consumer complaint levels of deterioration were ascertained.

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TIME-TEMPERATURE TOLERANCE OF FROZEN FOODS. IV. FLAVOR CHANGES IN FROZEN POULTRY PRODUCTS HELD AT —30° TO +20° F.

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Research on the tolerance of poultry products to a wide variety of temperature conditions has included studies of cut-up and whole chickens, whole turkeys, turkey pies, turkey and chicken dinners, and precooked frozen fried chicken. Fluctuating temperatures generally did not produce important special effects on flavor as compared with steady temperatures. Packaging or the degree of protection from the atmosphere is a critical factor in flavor stability. Microbial activity was specifically demonstrated only in samples held at +20° F. Poultry products generally are sufficiently stable so that there is little reason for poor-quality material to appear in distribution channels unless obviously bad practices or mistakes have occurred in the product's history.

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NONENZYMATIC DISCOLORATION OF GREEN BEAN PUREE

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Green bean purée, when heat-processed in sealed tubes, darkens to a degree proportional to the severity of the heat treatment received. Acetone-extracted (i.e. pigment-free) green bean tissue also darkens during heating. Chemical studies of color precursors showed that the discoloration may be due in part to the leucoanthocyanidins present. Delphinidin and cyanidin were identified in tissue heated under acid conditions. Pigment-free tissue turns red when processed below pH 4.0 and brown when processed above this pH. In the range of 50-85% solids, aqueous tissue suspensions were most susceptible to thermal darkening. Prior organic solvent extraction did not reduce the tissue's capacity for thermal discoloration, but conversion to holocellulose or cellulose resulted in thermally stable tissue residues.

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PREPARATION OF NEW AND IMPROVED PRODUCTS FROM EASTERN (DRY TYPE) SWEETPOTATOES: CHIPS, DICE, JULIENNE STRIPS, AND FROZEN FRENCH FRIES

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A number of varieties of Eastern grown (dry-fleshed) sweetpotatoes have been prepared in the form of chips, julienne strips and dice (cubes) by deep-fat frying, by methods previously described for other vegetables. These products were compared for crispness, toughness, color and flavor with chips made from moist or "yam" type varieties. French fried pieces were made under similar conditions of frying at varying times for use as frozen French fries. These were evaluated by taste panels after oven warming for periods similar to those used for frozen white potato French fries.

Yields of finished product based on unpared and trimmed weights of many of the different varieties were calculated. Moisture values of fresh dug, storage cured and 3 month stored sweetpotatoes of at least two varieties were determined and the moisture contents were related to the oil absorpion of the finished producs.

Carotene values were determined for several varieties, both fresh and after cooking, and the effect of storage for 3 months on the carotene content and the flavor was noted. A highly stabilized oil was used for this work so that no oil rancidity complicated the flavor determination.

The sweetpotato products were well received by consumer type panels representing both the housewife and the food manufacturer. As noted in our previous studies on other vegetables (white potatoes excluded) there was a difference of opinion between panel members in regard to the preference for a toasted taste as compared with a slight "raw" taste.

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FACTORS AFFECTING THE CONSISTENCY OF CREAMED SWEET CORN

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Consistency is one of the most difficult factors to control in the processing of creamed sweet corn. In a two-year study of creamed corn, test batches were prepared with varied amounts of starch and water and with corn of different maturities in a factorially arranged experiment. Samples of raw corn from each batch were also processed to determine the starch and moisture content of the cream and kernel components as well as their respective maturity grade.

The relationship between consistency at the time of filling to the consistency after processing and storage for 1, 3, 6, and 12 months as affected by the experimental variables is presented.

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STUDIES OF PROCESSED ALL GREEN ASPARAGUS. I. QUANTITATIVE ANALYSIS OF SOLUBLE COMPOUNDS WITH RESPECT TO STRAIN AND HARVEST VARIABLES, AND THEIR DISTRIBUTION WITHIN THE ASPARAGUS SPEAR

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Five strains of asparagus were harvested at 3 heights above ground, sorted into 3 diameters, processed in glass and analyzed for Folin-Denis reacting materials, ascorbic acid, rutin, titratable acid and pH.

Folin-Denis materials, ascorbic acid, and rutin increased on a weight basis with height of spear above ground, and with decreases in spear diameter. Titratable acidity increased with increase in height of spear above ground but did not change with spear diameter. The pH increased with height of spear above ground, but did not change with spear diameter.

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STUDIES OF PROCESSED ALL GREEN ASPARAGUS. II. EFFECT OF POST HARVEST STORAGE AND BLANCHING VARIABLES UPON THE CHEMICAL COMPOSITION

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Samples of freshly harvested asparagus were steam blanched at 3 temperatures for several different times, water washed, and processed in glass. The Folin-Denis, ascorbic acid, and rutin contents of these samples were determined. The pH, titratable acidity, and vacuum were measured. Similar samples of asparagus were water blanched at 212° F. for 3 minutes, processed, and analyzed as before. The results of the blanch treatments are compared.

The effect of 3 post harvest storage conditions upon the chemical composition of the processed product was also determined.

85

HIGH VISCOSITY OF CELL WALL SUSPENSIONS PREPARED FROM TOMATO JUICE

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Viscosity of tomato juice was doubled and even tripled by removing the soluble components from the juice. For example, viscosity was increased from 230 apparent centipoises (cp.) to 700 cp. by washing the juice on a fine sieve. The washed product resembled a puree in consistency, although its solids content was only 0.7%. Viscosity remained high following the addition of soluble non-ionic substances such as sugars, but was reduced greatly by the presence of electrolytes. Even the small amount of electrolyte occurring naturally in fresh tomatoes was sufficient to hold viscosity at a relatively low value. Microscopic observations and chemical tests showed that high viscosity was associated closely with the cell wall fraction of the juice. Pure cellulose walls at a concentration of only 0.2% gave a suspension as thick as the original whole juice containing 6.3% total solids. The commercial significance of these findings is being explored.

86

NUTRITIONAL EFFECTS OF MICROWAVE VS. CONVENTIONAL COOKING. I. RETENTION OF ASCORBIC ACID IN VEGETABLES

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Microwave heating, now available for household, institutional, and commercial cooking of foods, is highly efficient in the preparation of fresh and frozen vegetables for the table. In each case, the time required is much shorter than for conventional methods of cookery, and the color and flavor of the finished product are more desirable. It is of some interest to know whether better retention of naturally-occurring vitamins accompanies the savings in appearance, flavor, and time.

Fresh cabbage, fresh and frozen broccoli, and frozen green peas have been assayed for reduced and total ascorbic acid after preparation by microwave and conventional cooking. Simulated steam table holding of cooked vegetables, waterless cookery, and separate analyses of peas and residual liquid have been introduced as variables suggested by common culinary practices.

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EFFECTS OF CERTAIN BACTERIAL INHIBITORS IN COOLING MEDIUM ON SHELF-LIFE OF FRYERS

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An evaluation of the effects of chlorine and the antibiotics "Acronize" (chlortetracycline) and "Biostat" (oxytetracycline) on shelf-life of chicken fryers was made. Fryers were treated for 4 hours in the ice water cooling tanks.

Samples were taken from each lot at daily intervals for 25 days for bacterial evaluations (swab method). Fryers (both raw and cooked) from which swabs had been taken were evaluated by a panel for acceptability.

Based on raw evaluations and bacterial counts, Acronize was most effective in prolonging shelf-life (23 days). Fryers treated with Biostat were more variable in acceptability but some fryers remained acceptable for 23 days. No birds in either control lot or chlorine lot were acceptable after 18 days. The acceptability scores of the cooked fryers presented a different picture. The length of shelf-life as determined with cooked fryers was as follows:

Chlorine	7 days
Control	9 days
Acronize	21 days (some birds not acceptable after 7 days)
Biostat	21 days (some birds not acceptable after 9 days)

Acceptability scores of fryers from each lot declined steadily after 4 to 7 days after processing date.

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DELAYING VEGETABLE SPOILAGE WITH ANTIBIOTICS

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Antibiotic post harvest treatments were carried out on a variety of vegetables. The vegetables were stored at several temperatures and observed daily for microbial spoilage. Storage life of the vegetables was extended with several antibiotics. Dip treatments in oxytetracycline solutions materially delayed bacterial decay. Oxytetracycline afforded the greatest protection against vegetable spoilage.

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NEW METHODS OF PRESLAUGHTER ADMINISTRATION OF ANTIBIOTICS

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New ante-mortem injection techniques as well as refinements of the previously reported intraperitoneal injection are described. The relative advantages and disadvantages of these techniques are discussed. The influence of other agents in the antibiotic formulations on the antibiotic concentrations obtained in blood and tissue is reported. New processing techniques permitted by these discoveries are discussed.

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FURTHER STUDIES ON THE PRESERVATION OF BEEF WITH CHLORTETRACYCLINE

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Previous work from this laboratory has shown that *in vitro* sensitivity tests commonly used are not reliable in determining the effectiveness of chlortetracycline (CTC) in meat preservation work. Sub-inhibitory concentrations of the antibiotic as determined in nutrient media were found to be bacteriostatic against some organisms in beef. This phenomenon was also observed with oxytetracycline and tetracycline but not with chloramphenicol and streptomycin. Minimal inhibitory concentration of resistant organisms was found to be higher when determined by using nutrient media than when beef was used as a substrate.

A large number of strains of the two most frequently encountered chlortetracycline resistant genera on beef (*Proteus* and *Pseudomonas*) were found to be inhibited by very low concentrations of the antibiotic in beef. This inhibition was observed with inocula as high as 150,000 organisms per gram of beef.

Evidence will be presented which indicates that effectiveness of chlortetracycline in beef may be related to an induced nutritional deficiency for the bacteria.

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ANTIBIOTICS IN POULTRY MEAT PRESERVATION: COMPARISON OF THE TETRACYCLINES

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Effectiveness of chlortetracycline, oxytetracycline, and tetracycline for the preservation of chilled poultry was studied under commercial conditions. Eviscerated fryers were chilled for 2 hours in ice slush containing the antibiotic. The latter was added in sufficient quantity (allowing for dilution by melted ice) to provide a level of 20 p.p.m. Samples of fryers were cut-up, tray-packed, and plastic film wrapped on packing line in the plant, or were packaged as whole birds in polyethylene bags. All samples were then thoroughly iced and transported to the University for storage. Antibiotic-treated and untreated fryers were stored at 7.2° C. (45° F.). Additional untreated samples (controls for quality determination) were held on ice (±0° C. [32° F.]). Samples were removed from storage at intervals for microbiological and organoleptic evaluation.

Tray-packed fryers treated with chlortetracycline, oxytetracycline, and tetracycline, and untreated controls stored at 7.2° C. showed definite off-odor at an average (based on 4 different trials using panels of 6–14 judges) of 7.25, 6.5, 7.5, and 6.25 days, respectively. Eviscerated whole fryers were judged spoiled by the same criterion at respective storage ages (average of 2 trials) of 11.5, 9.0, 8.5, and 8.0 days. In general, total psychrophilic bacterial counts proved to be an unreliable index of organoleptic quality. Counts at the time of spoilage ranged from 1×10^4 to 1×10^7 organisms per square inch of surface. In several instances, counts as high as 1×10^7 organisms per sq. in. were found on birds judged to be normal in odor.

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RELATIVE EFFICACY OF THREE TETRACYCLINES WITH POULTRY MEAT

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Three antibiotics—tetracycline, oxytetracycline, and chlortetracycline—were compared at 4 storage temperatures for their ability to extend the shelf life of poultry meat.

Chickens were killed, scalded at 140° F. (60° C.) for 40 seconds, mechanically picked, eviscerated and chilled. After chilling and prior to packaging they were treated by immersion in a solution of 10 p.p.m. of the respective antibiotic for 15 minutes. Packaging was done by placing in a cardboard tray and then placing the tray in a polyethylene bag. Storage was accomplished by placing the packaged chickens in coolers held at 0° C., 3° C., 9° C., and 12° C. Spoilage was determined by observing for microbial growth, development of slime, and development of odor.

Half birds were used—4 halves for each treatment at each storage temperature. Three replications were made. In addition one series was treated at a commercial processing plant to compare the results obtained there with the results from the University plant.

Chlortetracycline was found to be the most effective at all temperature levels, although at the two higher temperatures, differences were small. Effectiveness of all antibiotics was greatest at the lower temperatures. Predominant types of microflora present at the time of spoilage were isolated. Types found on the untreated birds agreed with published findings. A number of the birds treated with the antibiotics were spoiled due to the growth of yeasts, especially at the lower temperatures ranges.

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COMPARATIVE EFFECTIVENESS OF TETRACYCLINE ANTIBIOTICS FOR FISH PRESERVATION

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Previous work at this Station, which was based largely on differences obtained in storing ground fish samples in which antibiotics were incorporated, indicated that chlortetracycline (CTC) was more effective than oxytetracycline (OTC) or tetracycline (TC) in retarding bacterial spoilage. The comparative effectiveness of these 3 antibiotics has now been assessed, using different species of fish and the following practical methods of application: (1) Incorporation of 5 p.p.m. of the antibiotic in the ice used for icing fish; (2) addition of 1-2 p.p.m. in chilled 3% salt solution used for holding eviscerated fish; and (3) addition of 5 p.p.m. to solutions used for dipping fillets. The results, which will be presented in detail, showed that CTC was more effective than the other two tetracyclines in retarding bacterial spoilage of treated fish.

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POTENTIAL APPLICATION OF ANTIBIOTICS IN THE SALMON CANNING INDUSTRY. II. CHEMICAL AND BACTERIOLOGICAL EVALUATIONS

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An experimental program was designed to test the feasibility and utility of certain of the antibiotics in the salmon canning industry under commercially practicable conditions.

Sockeye salmon *(Oncorhyncus nerka)* obtained upon arrival at a cannery were stored at 32° F., 40° F., and 50° F. in seawater brines containing 0, 5, 10, or 20 p.p.m. of either oxytetracycline or chlortetracycline. Other samples were obtained at the fishing grounds aboard a tender and were sprayed, immediately upon receipt, with seawater brines containing 0, 20, or 100 p.p.m. oxytetracycline. These were stored, dry, at ambient temperatures (60° F. to 70° F.).

At intervals during the storage periods, samples were removed, graded organoleptically, and prepared for canning. Representative portions of each fish in a sampling were comminuted, mixed, placed in cans, vacuum sealed, and sharp frozen. The remaining portions were hand-packed into cans and processed in the standard cannery manner.

Subsequently, organoleptic judgments were made of the heat processed samples by a group of experts from the industry. The results of the organoleptic judgments have been reported in a previous paper. The present paper presents the results of bacteriological examinations on the frozen raw samples and chemical estimations of spoilage (volatile acids and volatile bases

determinations) on both the frozen raw and heat processed samples. These results supplement the organoleptic judgments in establishing the efficacy of the antibiotics in extending the storage life of sockeye salmon under various storage conditions prior to processing.

95

ADVANCES IN VACUUM DEHYDRATION IN THE UNITED KINGDOM

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The application of vacuum contact dehydration to meat, fish, vegetables and fruits continues to be studied in the United Kingdom. Effects of compression and of accelerated storage tests on dehydrated vegetables are described, and in the case of meat and fish the newer development of freezing pre-treatment has been studied in relation to its effect on the quality of the final products. Further information is given on the effect of VCD dehydration on the vitamin content of animal tissues.

96

FREEZE-DRYING OF FRUITS

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Rates of lyophilization of Peaches were compared using different methods of heat transfer. Rate of H_2O loss under typical freeze-drying conditions was compared to rates using intra-red, dielectric, and double contact plates as heat sources.

Determinations were made of the relationships of particle size to water loss rate. The effect of heat acceptance area on drying rate was also studied.

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PINEAPPLE JUICE POWDER

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A method has been developed for making a pineapple juice powder from a commercial concentrate. A [illegible] Brix concentrate can be dehydrated in a short period at a pressure of 2 mm. and a final product temperature of 150° F. to give a high-quality product. The moisture level in the packaged powder can be reduced by in-package desiccation from 2.5 to 1% in less than 3 months by storage at progressively higher temperatures as the moisture decreases. Variables explored include: storage temperatures, can atmospheres, and effect of sulfur dioxide.

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DEHYDRATED COOKED MEAT PRODUCTS

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The rapid vacuum freeze-drying process recently developed in this laboratory has been found of value in the dehydration of cooked meat items. Meat slices up to one inch in thickness may be freeze-dried to a moisture content below 2% in 3–5 hours. This fast rate of drying is achieved using a conventional vacuum chamber in which the meat is laid between heater plates fitted with aluminum spikes which penetrate and conduct heat into the tissue uniformly and efficiently, during the drying cycle.

Cooked meats that have been dehydrated in this way include roast turkey, slices of roast meats, braised round beef, cooked chicken, and ground beef and frankfurters.

The dried meats are rehydrated in hot water or in a suitable gravy and are, in general, ready for eating in less than 10 minutes. Products such as these may find a place in the development of quick-serve meals for use by the Armed Services and could be of commercial interest.

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QUALITY OF DEHYDRATED PEAS IN RELATION TO MATURITY

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Green peas were harvested on consecutive days and graded so that each size could be treated separately according to standard preparation and dehydration procedures.

Moisture content of the blanched peas decreased with increasing maturity so that less dehydrator capacity would be required for older peas to produce a given quantity of dried peas at a specified moisture level. On the other hand, the younger peas dried to a lower moisture content which is advantageous when a low moisture content is required for good storage stability. The formation of a brown pigment, considered to be indicative of loss in quality, was more extensive in young peas and decreased with increasing maturity until an alcohol insoluble solids of 12% was reached; beyond this maturity, the amount of browning was low and relatively constant. Evidently, young peas are heat sensitive and require the lowest possible drying temperatures. Water absorption was measured as the Rehydration Ratio of water taken up to the weight of dried peas or as the Rehydration Index when the weight of peas was recalculated in terms of moisture-free solids to eliminate differences in solids content due to maturity. The Rehydration Ratio varied inversely with maturity while the Rehydration Index increased directly with maturation. Texturemeter readings on the rehydrated samples varied directly with maturity. Taste panel evaluation of the flavor, texture and color of cooked dehydrated peas showed that optimal quality was obtained in the range of 9 to 19% alcohol insoluble solids which corresponds with tenderometer readings varying from 85 to 95.

The optimal maturity of peas for dehydration appears to be in the Tenderometer range of 85 to 95; and considering the danger from browning and the low drying yields of young peas, the upper limit of this range is to be preferred.

100

PRODUCTION TESTING OF CALCIUM CHLORIDE TREATED DEHYDRATED POTATOES

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The application of calcium chloride to diced white potatoes for control of texture and inhibition of non-enzymatic browning has been demonstrated on a production basis. Cost estimates have been prepared. Spray application was found superior to immersion in solutions of calcium chloride. Potential corrosion hazards are discussed.

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POTATO VARIETIES IN DEHYDRATION OF MASHED POTATOES BY THE FLAKE PROCESS

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In the production of dehydrated mashed potatoes in the form of potato flakes, as in other processes, evaluation of the raw material is important. In pilot plant operations during the past 3 years a considerable number of potato varieties have been found acceptable. The characteristics of these varieties important to processors have been evaluated, among them the average solids content as measured by specific gravity and the starch content. The losses incurred in lye peeling at 150° F. and in trimming have been measured. The range of specific gravity of different shipments, determnied by brine grading into narrow specific gravity fractions, has been determined.

The Russet Burbank variety is grown in many areas. Characteristics of shipments of this variety from different areas of the country are compared.

102

A NEW TREATMENT OF HYGROSCOPIC EQUILIBRIA: APPLICATION TO WALNUTS AND OTHER FOODS

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A new formula, containing two constants, has been devised for the expression of hygroscopic equilibria data. The empirically derived equation relating moisture content and equilibrium relative humidity is applicable to all moisture bearing materials for which data have been available. Complete curves may be derived from minimum of experimental data. The new treatment has been applied to the construction of hygroscopic equilibrium curves for both in-shell and shelled English Walnuts *(Juglans regia)* as well as to a variety of other agricultural commodities. Compared with other equations which have been used to relate moisture content and equilibrium relative humidity, the new treatment yields curves which fit the experi-

mental data to a finer tolerance over the complete humidity range. Rapid procedures have been devised for the estimation of moisture and relative humidity in both in-shell and shelled walnuts using modifications of commercially available electronic instruments.

103

AN ELECTRONIC DEFECT COUNTER FOR MEASURING THE DEFECTS FACTOR IN FOODS

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The defect counter consists of a photoelectric scanning device which scans discrete areas of two square millimeters. Thus, areas whose light reflectance is reduced to 50% of the normal reflectance are tallied on a counter. The sample passes continuously under the scanner so that a 100% examination is accomplished. Results of the application of this instrument on the grading of applesauce for defects are presented.

104

MODIFICATION OF THE SHEAR PRESS FOR ELECTRICAL INDICATING AND RECORDING

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Since its introduction in 1950 the shear press has found increasing use in both research and commercial organizations. Applications have ranged from evaluating produce varieties to determining quality for cost determination. It was found that a continuous record of force variation as the sample is deformed provides quality information in addition to that obtained by the conventional maximum force values. Force recording provides a permanent record, which can be analyzed at some future time, thereby reducing much of the operator error.

Electrical indication and recording is advantageous since range changing can be accomplished simply and conveniently; the system is convenient to operate and is rugged in nature; cost can be reduced over that of a purely mechanical system. The shear press can thus be used for a wider variety of products since its range can be made to fit the product. Full scale recorder deflections can be varied from 50 to 2500 lbs. using a 2500-lb. maximum spring-type dynamometer as the force measuring device.

105

TEXTURAL QUALITY OF FOOD PRODUCTS AS DETERMINED FROM FORCE DISPLACEMENT RECORDINGS

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The recent adaptation of shear resistance instruments for electrical indicating and recording provide the possibility of obtaining not only maximum force, but complete force displacement curves which may be integrated in terms of pounds-inches of work.

Data are presented on asparagus and other products, showing that such work measurements may be adjusted more precisely for variations in sample size and speed of stroke. They are not influenced by the stratification or the size of units in the sample, and provide information not only on average texture but also the distribution and variability of textural quality within the sample.

106

A STRAIN GAGE PEA TENDEROMETER INSTRUMENT. DESCRIPTION AND EVALUATION

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A new electronic instrument for the rapid and semi-automatic measurement of tenderness of individual peas is described. Strain gages and associated conventional electronic equipment which records this information in digital form are used. The input transducer utilizes two pairs of opposing molars that simulate mastication of the individual peas. The instrument receives and masticates the peas one at a time, semi-automatically, and the machine is self-cleaning after each single bite thus making possible the rapid operation.

A 10-channel differential discriminator operated by a system of relays, constitutes the output transducer.

Distribution data on the tenderness of field run peas showed a good correlation with qualitative subjective observations and with both the standard and the newer means of measuring these characteristics.

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APPLICATION OF SPECIFIC-GRAVITY TECHNIQUES FOR EVALUATING SWEET CORN QUALITY

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Three methods, which involved the specific-gravity principle, were evaluated to determine the quality of raw, canned, and frozen whole kernel sweet corn. Two of the methods employed the principle of weighing the sample in air, weighing it in water, taking the difference of the weight in water from the weight in air and dividing this difference into the weight in air. These two methods differed with respect to sample size: one used an approximate 100-g. sample and the other a 6-pound sample. The third method was based on the use of a modified Potato Chip Institute potato hydrometer.

The specific gravity techniques were compared with some of the chemical constituents of whole kernel corn; the Tenderness and Maturity Score of the U. S. Standards for Grades of Canned and Frozen Whole Kernel (White Grain) Corn; and some of the presently used sweet corn quality tests: percentage of alcohol insoluble solids, moisture percentage, percentage of pericarp and succulence. The alcohol insoluble solids determination was considered the most satisfactory individual quality test for purposes of evaluating the specific-gravity methods.

108

NON-DESTRUCTIVE MEASUREMENTS OF THE INTERNAL COLOR OF TOMATOES

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Instrumentation is described for measuring the spectral transmission of whole fruits and vegetables. Further application of this technique to a practical problem, i.e., measuring the average color of tomatoes is described in detail.

Spectral transmission curves of intact tomatoes in the 400 mμ to 900 mμ region of the spectrum are included. The criterion for evaluating the red color of tomatoes is a ratio between the transmission of light at two different wavelengths, i.e., 620 mμ and 670 mμ. The criterion for green tomatoes is a ratio between the transmission at 520 and 545. A portable field instrument to make these measurements is described also. A correlation coefficient in the order of 0.95 between the transmission measurement and a measure of the color of the tomato juice as measured by the Hunter Color Difference Meter is shown as an indication of the practicability of this type of measurement.

109

OBJECTIVE CRITERIA FOR STORAGE CHANGES IN TOMATO PASTE

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Tomato paste made by the hot break process containing 26% total solids was stored at 6, 20, 25, 35, 45, and 55° C. Samples were taken at different time intervals and tested for changes in color, flavor, and chemical constituents. Results indicate quality of tomato paste deteriorates rapidly at high storage temperatures. This was accompanied by decrease in ascorbic acid, amino nitrogen, and vacuum, and increase in serum color, hydroxymethyl furfural, titratable acidity, and tannin-like substances. Among these, determinations of serum color and hydroxymethyl furfural content were found to be more promising as objective criteria for quality control. The importance of storage temperature to shelf-life of canned tomato paste is discussed.

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OBJECTIVE VALUATION OF COLOR AND CONSISTENCY IN PEACH PUREE

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New York State Agricultural Experiment Station
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Geneva, New York

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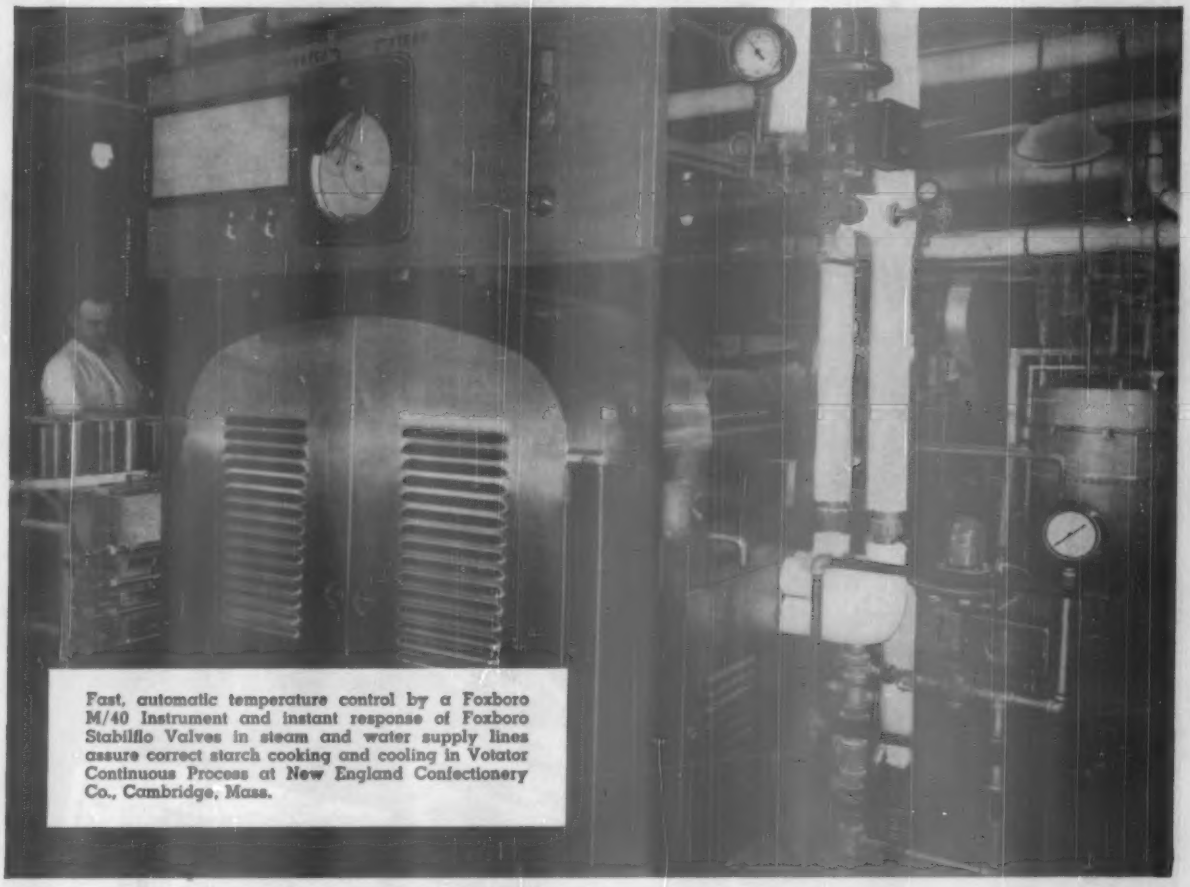

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SPECIAL FLAVORS FOR PREPARED CAKE MIXES, PREPARED ICINGS AND PUDDINGS

Establishment of objective measurements of peach puree color and consistency is part of a study designed to improve the quality of purees made from eastern-grown freestone peaches. These indices are being used to evaluate the effect of harvest maturity, post-harvest ripening and processing variables on the quality of freestone peach puree.

This paper deals with the preparation of experimental samples (representing a wide range of color and consistency), the selection of a panel of judges and the conditions under which subjective and objective evaluations of color and consistency were conducted.

The interpretation of correlations relating multiple comparison test scores to Hunter Color and Color-Difference Meter and Brookfield Synchro Lectric Viscometer values are emphasized.

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A QUALITY CONTROL APPROACH TO OPTIMUM MACHINE SET-UP

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Use of sampling techniques, called Equipment Set-Up Procedures, in obtaining optimum set-up of equipment is described. The basic concept involves devoting concentrated effort to achieving an optimum set-up prior to commencing production, thereby obtaining a production run of (a) uniformly high quality and (b) reduced downtime for corrective adjustments.

Processes where this approach is most applicable may be characterized as highly mechanized, involving long production runs, and once set to a given dimensional level tend to remain there.

Optimum set-up for a given dimension is achieved when a process is so adjusted that its process average is equal to the specified nominal, or midway between the upper and lower limit. The set-up can be judged by sampling and comparing the average sample results to the specified nominal.

After proper study of the particular inherent variation of a process, it is possible to design a sampling plan which, with predetermined risks, will provide assurance of accepting a good set-up and rejecting a poor set-up. Essentially the plan includes a sample size and set-up limits within which the sample average must fall.

In actual use the results of the sample evaluation are posted on a worksheet in the form of a frequency distribution. This portrays graphically the machine set-up in relation to the specified nominal; it also facilitates "visual averaging" of the results, which is done by using the median as the average. The procedure itself is geared to practical on-the-floor use, and may be adopted for use in many operations.

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SQC APPROACH TO THE USE OF MULTIPLE REGRESSION IN FOOD RESEARCH

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Multiple regression and correlation are valuable techniques in solving certain food packaging problems. When a combination of many measurable factors produces one result, they are the only methods which will evaluate the relative effect of each factor. The application of these techniques is usually a time consuming, lengthy process when many factors are present. However, in the majority of cases, a small number of the factors account almost entirely for the total correlation. Using the SQC approach it is possible to hunt for small combinations of factors which will add almost completely to the total multiple correlation coefficient. The formal approach has been either to delete factors one by one from the complete matrix until a dropping off point is reached, or to test the significance of the regression coefficients using Gauss multipliers, and to delete those which are not significant. The authors deviate from the formal approach by running the complete matrix of all factors to find the maximum value of R^2, then, starting with the factor having the highest simple correlation coefficient, remaining factors are added one by one until the maximum value of R^2 is approached, indicating that the dominant factors have been located. This method is illustrated with data accumulated in our container research laboratories, and the approach can be checked by an analysis of variance for complete components.

The application of these techniques to a seven-factor food research problem is shown and the technical interpretation of the statistical results is also presented. This particular approach to multiple correlation and regression need not be confined purely to container studies. The analytical method can be used wherever the data are on continuous measurable scales. Since linearity of the data is assumed in the analysis, transformations may be employed to achieve approximate linearity when the original measurements are not on a linear scale.

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STATISTICAL CONSTRUCTION OF OBJECTIVE QUALITY SCALES

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Formation of quality scales when physical characteristics are measurable is relatively simple. By use of the method of least squares, the regression line relating the physical measurement to a subjective quality scale may be drawn and variation of rating or scoring panels may be estimated.

Some quantities or properties of a complex physical nature, such as taste, odor, wholeness, firmness, product breakdown, etc., are not easily measured and formation of quality scales then becomes more difficult. However, by the use of least squares, the relationship between a degrade rating and a subjective quality rating may be determined. The variation in the scoring or rating panel may also be estimated. Numerical weights may be attached to total acceptability either by multiple regression techniques, by the reciprocal of the variance, or by the slopes of the individual regression lines. It is also possible by using either the geometric or the harmonic mean in scoring systems to produce an automatic zero total score if any one of the faults in the total score is zero.

The statistical construction of various objective quality scales is outlined in this paper and illustrated by representative data.

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APPLICATION OF SQC PROCEDURES TO THE CANNING OF GREEN PEAS

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Statistical quality control procedures are demonstrated as they apply to the selection of reliable growers, sampling inspection of the raw product, control charts on snipping and fill operations, and finished product inspection.

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SAMPLING PLANS DEVELOPED BY U. S. DEPARTMENT OF AGRICULTURE FOR INSPECTION OF PROCESSED FRUITS AND VEGETABLES

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The development of single and multiple sampling plans for destructive sampling is described with respect to the practical and statistical aspects.

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ON THE APPLICATION OF LINEAR PROGRAMMING TO THE OPTIMAL CHOICE OF RAW MATERIALS

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Choice of raw materials ultimately used in a given manufacturing process is usually restricted in a manner to insure first, that certain quality specifications are satisfied and, second, that the cost of the eventual technological adjustment of raw materials is minimized. Very often, the quality specifications of the manufacturing process itself require blending several groups of raw materials of the same type but of different quality characteristics. Because of the general practical implications of the blending technology, attention is given in this report to the optimum programming connected with this activity. It is assumed that only material costs of raw materials and their physico-chemical adjustments enter our problem.

In its theoretical part, the paper shows that the set of physical and chemical specifications $y_i - (i = 1, \ldots, m)$ of a combination of n given (component) raw materials is connected with their respective concentrations $x_j - (j = 1, \ldots, n)$ by a set of m linear equations: $y_i - = a_{i1}x_1 - + \ldots + a_{in}x_n - (i = 1, \ldots, m)$. The coefficients a_{ij} stand for or are associated with i-th physical (or chemical) property contributed by the j-th component. The problem of optimum programming is then to find nonnegative values x_j which satisfy the above indicated constraining equations together with a possible additional set of other technological restrictions and simultaneously minimize the cost of the final product resulting from the blending operation. Evidently, this is a typical *linear programming*

problem. In the empirical part of paper, the techniques are used for calculation of optimal blending programs for fats, flours, and liquid sugars as complementary to typical food manufacturing processes.

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CONTROL OF MOISTURE IN GRANULAR PRODUCTS

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Control of moisture in many granular products has presented a problem for a considerable time. A means has been found to do this automatically and continuously in at least one product. It is assumed that the extension of the technic employed to other products can be readily accomplished. This will pave the way for the application of automatic control to many food processing operations.

The means which have been used in several successful applications are pointed out. Results, performance, and the resulting improvement in product are documented. Not only is product quality improved and made more uniform, but the method also smooths out or eliminates some troublesome production problems. With proper evaluation of fundamental information obtainable by this method the way to the probable solution of many difficult process problems is indicated.

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CONTINUOUS LABORATORY-SCALE JELLY MANUFACTURE

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A process for the use of full-flavored fruit juice concentrates in jelly-making has been developed. Juice concentrates are readily adaptable to continuous manufacture of jelly, because no cooking to remove water is necessary. This makes possible a process involving only mixing of jelly ingredients and application of heat sufficient to dissolve pectin and to pasteurize the jelly. The equipment required is not expensive and the process can be readily controlled to produce a uniform jelly of high quality.

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HIGH-DENSITY FRESH FLAVOR PEACH CONCENTRATES BY A CONTINUOUS PROCESS

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Frozen peach concentrates, retaining the characteristic fresh flavor of the fruit, have been prepared by a continuous process. The products made were:

(1) A 7-fold puree concentrate for enhancing peach ice cream flavor;
(2) A 4-fold nectar concentrate for beverage use; and
(3) A 9-fold clear juice superconcentrate for jelly manufacture.

Processing consists of pitting, peeling, pureeing, enzyme inactivation, depectinization, juice fiber separation, aroma recovery, juice concentration and restoration of concentrated aroma. A filtration step is included when preparing clear superconcentrate. Peach fibers are reincorporated in the juice concentrate for the puree and nectar.

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EFFECTS OF JAR SIZE, LIQUOR, AND PRODUCT-TO-LIQUOR RATIO ON HEATING CHARACTERISTICS OF FRESH-PACKED PICKLE PRODUCTS

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An investigation was made of the variables that affect the lethality of the pasteurization given fresh-packed pickle products. The following factors were considered: size and geometry of jars, type of liquor, product-to-liquor ratio, and shape of the pickle product. Whole, slice, and spear shapes were studied. The effect of increased product-to-liquor ratio was evidenced by an increased lag factor (j) and an unchanged heating rate (f_h). Syrup products were found to require longer heating times to achieve equivalent sterilizing values. Spear products in syrup were found to have heating characteristics approaching those of a 5% Bentonite suspension. Relationships between lag factor (j), heating rate (f_h), sterilizing value (F), liquor, and product type were investigated.

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HEAT CONDUCTION THROUGH THERMOCOUPLE WIRE A FACTOR IN HEAT PENETRATION MEASUREMENT

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Some heat penetration measurements are subject to error because of heat conducted through thermocouple wires. Commonly the effect is of such magnitude as to cause important errors in calculated sterilizing process specifications. Results of this study show that the slope of the heating curve, the f_h factor, is influenced to a considerable degree. Accounting for this deviation in heating data, caused by induced temperature gradients, is especially important in calculation of processes assigned to conduction-heating products. Investigations were carried out using various can sizes and product consistencies. Correction factors to give closer approximations of true heating curves are offered.

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ELIMINATING PRESSURE CANNING OF VEGETABLES

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The low acidity of vegetables such as are commonly canned now requires relatively high pressure to insure a high enough sterilizing temperature and results in some damage to flavor, quality or texture. The Rahn split-salt method permits canning of such vegetables at the ordinary boiling water temperature commonly used for acid foods such as tomatoes. Only ordinary salt in usual amount is added, but in two chemical steps.

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STABILITY OF FROZEN CONCENTRATED ORANGE JUICE. IV. SEASONAL AND VARIETAL FACTORS AS RELATED TO HEAT STABILIZATION

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Fruit of Hamlin, Pineapple, and Valencia varieties were processed into frozen concentrates at frequent time intervals during normal harvesting periods for the respective varieties. Packs with heat treatments of 150, 160, 170, and 180° F. and unheated controls were prepared. Concentrates were examined for pectinesterase activity, cloud stability, and flavor.

Valencia orange concentrates were more stable than either Pineapple or Hamlin concentrates. In turn, the Pineapple concentrates were somewhat more stable than that of Hamlin. In storage at 40° F., concentrates from Hamlin orange juice heated at 180° F. retained cloud stability for only 7 days while similarly treated Pineapple products remained stable for 14 days. Valencia concentrates remained stable for much longer periods even if heat treatments of only 150 or 160° F. were used.

No effect of heat treatment on flavor of the products was observed in the Hamlin or Valencia concentrates; however, a flavor difference was observed in late season Pineapple products which had received heat treatments of 170 or 180° F.

There was little or no effect of maturity on the percentage of enzyme inactivation for the Hamlin and Pineapple varieties; however, heat treatments at 150 and 160° F. inactivated a greater percentage of the enzyme in the early season Valencia variety than later in the season. No effect of maturity was observed in the cloud stability of Hamlin and Pineapple products while early season Valencia products treated at 150 or 160° F. were more stable than those of late season production.

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STABILITY OF FROZEN CONCENTRATED ORANGE JUICE. V. EFFECT OF HEAT TREATMENT AT INTERMEDIATE STAGES OF CONCENTRATION ON JUICES PREPARED FROM VALENCIA ORANGES

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Over a 3-year period, studies were made on the effect of heat treatment at several stages of concentration on cloud stability,

flavor, and pectinesterase activity of frozen concentrated orange juice made from Valencia oranges. In the first season's study, heat treatments of 140, 160, 180, and 200° F. were applied to single strength juice and at concentrations of 22°, 42°, and 55° Brix. In the second and third season's work, heat treatments of 150, 160, 170, and 180° F. were applied to single strength juice and concentrates of 20°, 26°, 32°, and 38° Brix.

From the standpoint of pectinesterase inactivation, no significant difference was noted between the intermediate concentrations under study at any specific heat treatment, but it was shown hat inactivation was less effective with single strength juice than it was at the intermediate stages of concentration.

With respect to cloud stabliity, heat treament at 140° F. was ineffective at all concentrations, and no advantage was demonstrated for 200° F. over that above 180° F. treatment. In the first two seasons' work, all products heated in the range of 150 to 180° F. at intermediate concentrations remanied stable at 40° F. for the normal observation period of 6 weeks while treatment of single strength juices was less effective particularly at the lower temperatures. In the third season's work, cloud stability was markedly different primarily due to equipment modifications, effected to produce juice more nearly representative of commercial operations. A more rapid loss of cloud was noted in all samples, but the advantage of treatment at intermediate concentrations was more pronounced. There was a slight increase in effectiveness of heat treatment with increased concentration at which the treatment was applied.

No differences in flavor were noted in the products prepared in the first and second seasons' work, but in the third season's work, there was a significant difference (1% level), although not objectionable, between controls and products heat treated at 180° F.

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A TWO-SEASON SURVEY ON THE FLAVOR OF FLORIDA FROZEN CONCENTRATED ORANGE JUICES

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The flavor of over 400 samples of frozen concentrated orange juices was evaluated by a small taste panel that averaged 7 persons. During the 1953-54 citrus season, 221 samples were collected semi-monthly from all of the commercial plants in Florida; 215 samples were obtained during the 1954-55 season. The procedure used for the evaluation of the flavor of these products and results based upon 7394 individual flavor grades will be presented. Some of the factors that determine the flavor of frozen concentrated orange juices as well as types of off-flavors that may occur in these products will be discussed briefly.

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FACTORS THAT DETERMINE STORAGE CONDITIONS NECESSARY TO MAINTAIN THE QUALITY OF FROZEN CITRUS CONCENTRATES

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Recommended temperature for the storage of frozen citrus concentrates has been 0° F. or lower. As the temperature of storage for these products is increased above 0° F., changes that affect quality occur at a faster rate; also, concentrates that have been stored at temperatures above 0° F. deteriorate faster, if later abused by storage at higher temperatures, than do those previously stored at 0° F. Certain types of off-flavors may develop in frozen concentrated citrus juices even when they are stored at 0° F. Commercial frozen citrus concentrates do not have the same degree of stability; therefore, storage conditions should be such that the quality of all products will be maintained. Information available and existing circumstances which necessitate that frozen citrus concentrates should be stored at 0° F. or lower will be discussed.

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COLOR STABILITY OF FROZEN BEEF AS INFLUENCED BY ILLUMINATION, TEMPERATURE AND STORAGE

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An evaluation of the factors affecting the utility of transparent films for consumer packages of frozen beef is presented. Beef round steaks were vacuum packed in flexible transparent films. The samples were stored in the dark at 0° F. for 0, 1, 2, and 4 weeks prior to illuminated display. The product was displayed at several sub-freezing temperatures. The samples were displayed under 25 and 50 foot-candles of illumination up to 7200 foot-candle-hours. The color was evaluated by a panel and with a Photovolt Reflectance Meter at uniform intervals during the test.

The stability of the color of frozen beef is related to the length of dark storage, foot-candle-hours of illumination and temperature of the storage cabinet. Color is also affected by the type of packaging film used. Color transparencies provide excellent visual comparisons of results.

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FACTORS AFFECTING THE STABILITY OF FROZEN WHITE SAUCES

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Separation of liquid from frozen sauces thickened with ordinary starches or flours appeared to be largely the result of retrogradation of the starch, accompanied by certain secondary changes. Introduction of cross-linkages into waxy corn or waxy sorghum starch did not prevent the liquid separation but delayed the loss of colloidal material from the separated liquid, thus prolonging the time when the sauce appeared to be acceptable.

Structural differences in amylopectins from different sources appeared to cause wide variations in their tendencies to separate after freeze-thaw treatment. Amylopectin from tapioca starch exhibited much greater stability than amylopectins from sago or waxy corn starch. Stability of granular waxy rice starch occupied a position between tapioca amylopectin and the other two. Tapioca amylopectin and waxy rice flour produced white sauces of about the same stability, greater than that of any of the other thickening agents tested. A paste of tapioca amylopectin and water alone was much more stable than a white sauce containing the same starch fraction. However, a paste of waxy rice flour and water alone was much less stable than a white sauce containing this flour. Thus, other ingredients of white sauce appear to have a pronounced effect on stability, as does the non-starch fraction of waxy rice flour.

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PANELS OF JUDGES FOR FOODS AND BEVERAGES

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In acceptance analysis there is a need for the organization of the kinds, of the sizes, and of the methods of selection of members for panels of judges of foods and beverages, and of the methods whereby decisions are derived from these different panels. Single and repeat tests by individual experts, by several specialists, by laboratory staff, and by large-scale consumer panels of differing status have in the past been selected by many different methods, which should be evaluated as to their advantages, disadvantages, and limitations.

An analysis of these factors reveals the need for more research directly applied to this problem of panel selection. Furthermore, the research should be of concern to investigators with different types of opportunities available to them. Even in nation-wide acceptance operations, as for the development of rations for the Armed Forces, or for national or foreign population nutrition, all types of panel problems are seldom encountered in their entire range and variety by any one investigator or investigating organization.

In addition to a consideration of some of the principles of panel selection and composition currently accepted, some new base-lines are suggested for use in any proposed development of recommended rules or procedures in panel selection in the future.

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SELECTION OF A TASTE PANEL FOR EVALUATING THE QUALITY OF PROCESSED MILK

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Threshold tests for tallowy and proteolytic flavors in nonfat dry milk and for storage and rancid flavor in dry whole milk were the means used for determining the taste acuity of 20 persons (10 men and 10 women) for these specific flavors. The experimental design provided 20 replications of paired comparisons of control milk versus off-flavored milk. Ranked paired comparison tests were also given to show potential judges' ability to differentiate degrees of cooked flavor in evaporated milk.

Four different milks, each processed to have a high concentration of one off flavor (tallowy, proteolytic, storage, or rancid), were used in 3 or 4 concentrations and diluted with fresh whole milk, to provide samples for tasting. Milks made up for

the tests contained 6, 8, 12, and 16% tallowy-flavored milk; 8, 12, and 16% proteolytic-flavored milk; 10, 20, and 40% storage-flavored milk and 2, 4, 8, and 12% rancid-flavored milk.

In the phase of the study using ranked paired comparisons, two samples of evaporated milks representing high heat and conventional methods of processing were made up to double volume with distilled water. Twenty and 40% dilutions of each in fresh whole milk were prepared. The control sample for these tests was fresh whole milk. Each of the 5 samples was paired with the other 4 samples four times according to the statistical design provided.

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THE HEDONIC SCALE METHOD OF MEASURING FOOD PREFERENCE

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The hedonic scale method was developed by the Quartermaster Food and Container Institute in 1949 and has come to be widely used both within the Armed Services and by industry. The scale has 9 categories described as successive degrees of liking, ranging from *dislike extremely* to *like extremely*. Research has shown that this form may sometimes be varied to advantage. The stimuli are presented singly. The method works well with trained or naive subjects and is appropriate for laboratory or field use.

The scale and methods for its use are described, with primary emphasis on laboratory testing, and the following points are discussed: (a) relationship to other types of testing; (b) control of constant errors; (c) psychological and physical control in the test situation; (d) appropriate experimental designs; (e) sensitivity and reliability of the results, (f) validity as a predictor of food acceptance; (g) new modifications of the scale.

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METHODS FOR RATING QUALITY AND INTENSITY OF THE PSYCHOLOGICAL PROPERTIES OF FOODS

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Rating or scoring food and beverage items requires a scaling of the responses of individuals against some clearly defined frame of reference. The scaling may involve only a simple rating of the intensity of a certain quality, or it may require a judgment about the desirability of the quality in question. A number of more or less standardized scales are available, each with its own interpretation requirements.

Some of the difficulties and principles of scale construction are discussed. Emphasis is given to the problem of linearity of the scale, but the discussion avoids the more complex statistical techniques.

Finally, examples of the more adequate measuring systems applied to specific food and beverage products are given and reviewed.

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METHODOLOGY OF THE FLAVOR PROFILE

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The flavor profile is a semiquantitative descriptive analysis of aroma and flavor. It is based on the natural process of evaluating and comparing flavors by describing their impressions—as a whole and by their individual characteristics. The dimensions of flavor analysis by this method include (a) over-all impressions of aroma and flavor, referred to as amplitudes; (b) perceptible aroma and flavor factors; (c) degree of intensity of each factor; (d) order in which these factors are perceived; (e) aftertaste. Purpose of the flavor profile is to record a reproducible flavor analysis in which all flavor components can be considered in proper perspective. The comprehensive nature of the method permits its application to a variety of problems.

Like all scientific tests, profile analyses are conducted under standardized and controlled conditions. The profile uses trained but unspecialized panels. Training includes not only practical sniffing and tasting techniques but also exposure to a variety of flavor and odor situations, because in any descriptive method precision depends upon the articulateness of the panel. Several panel sessions per product are necessary to ensure reproducibility and accurate results. Details of panel procedures and techniques will be discussed.

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CONSUMER ACCEPTANCE METHODOLOGY: ONE VS. TWO SAMPLES

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The number of samples submitted to participants for evaluation and/or comparison is an important factor in consumer testing. A review of the studies concerning the presentation of one, two, or more samples is included with a discussion of the advantages, disadvantages, and limitations of the techniques. Original data obtained on sweetness/acid preference in canned cling peaches from approximately 6000 consumers at the 1956 California State Fair are presented to illustrate a comparison of three techniques: single sample, hedonic scale rating; two sample, hedonic scale rating; and two sample, preference rating.

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STUDIES LEADING TO THE DEVELOPMENT OF A SIMPLIFIED "UNIFORM PROCEDURE FOR MAKING FLAVOR DIFFERENCE EVALUATIONS OF CANNED FOODS

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During 1950 and 1951 the canning industry encountered numerous cases of off-flavor in canned foods which were thought to be due to the application of pesticides to the canning crop. A conference, sponsored by the National Canners Association, was held in San Francisco in 1951, to discuss this problem of physiological effects of pesticides on the flavor of canned foods. It was the consensus at this meeting that a cooperative and coordinated research program should be initiated by the California Agricultural Experiment Station in cooperation with industry to determine the effects of applied chemicals on flavor changes in canned foods. Subsequently, preliminary work by several states disclosed a need for more uniformity in making organoleptic flavor difference tests. Therefore a conference of food technologists from universities, experiment stations, and the industry was held in Chicago in 1953 to discuss ways and means of developing a simplified, uniform taste test procedure.

The California Experiment Station prepared canned pear samples from plots treated by the Entomology Division in 1953 and 1954, and these samples were sent to ten cooperating laboratories the first year and eleven the second. Tomato juice samples were prepared in 1955 by the Ohio Experiment Station employing an additive procedure and distributed to the eleven cooperating laboratories.

The collaborators through cooperative efforts prepared a simplified or modified triangular procedure which was used in 1953 and further modified the second and third years. A "simple multiple comparison" method suggested by the Food Committee of the American Society for Quality Control was also used during 1955. The development of these two final methods will be discussed. The results indicate the necessity of having a uniform method of selecting and training judges if a fairly high degree of precision is desired. They also show that a fairly high degree of precision can be obtained by different laboratories when a comparatively simple, uniform test procedure is used.

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THE NORTHEAST REGIONAL APPROACH TO COLLABORATIVE PANEL TESTING

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In July 1954, a technical committee of the Northeastern Experiment Stations comprised of home economists, horticulturists, entomologists and food technologists initiated a project (NE 15) to study the effect of pesticides on the quality of fruits and vegetables. The objectives of this project were: (a) to develop a standard and uniform method to evaluate flavor changes (b) to determine the effects of some pesticides on the quality of selected fruits and vegetables (c) to devise counter-acting agents or methods. Contributing projects from Connecticut, Maine, Maryland, Massachusetts, New Jersey, New York and Pennsylvania have followed the general objectives of the program.

The first phase of this work has resulted in the adaptation, under regional conditions, of a multiple comparison or variables method for measuring pesticidal flavor changes and the introduction of a standard and uniform procedure to serve as a guide for other work in evaluating flavor changes, thus helping to standardize reporting and evaluating of experimental results.

Organizational details of selecting test materials, choosing type and intensity of pesticide treatments, developing uniform scoring systems and test forms, training of judges, designating panel size, measuring panel efficiency and analyzing results by standard statistical procedures are presented for this collaborative work.

determination of absorbancy at a single wavelength using the Beckman Model DU Spectrophotometer equipped with 1-cm. absorption cells. It is similar in principle to the potassium dichromate-cobaltous chloride method, but employs an objective photoelectric instrument in place of the human observer and is therefore considerably more accurate and convenient.

LITERATURE CITED

1. Guenther, Ernest. *The Essential Oils.* Volume I, p. 330. 1948, D. Van Nostrand Company, Inc., New York, N. Y.
2. Hardy, Arthur, C. *Handbook of Colorimetry.* 1936, The Technology Press, Cambridge, Mass.
3. Judd, Deane B. *Color in Business, Science, and Industry.* 1952, John Wiley & Sons, Inc., New York, N. Y.
4. Moster, J. B., and Prater, A. N. Color of capsicum spices. I. Measurement of extractable color. *Food Technol.*, 6, 459 (1952).
5. Rhein, E. J. Kimble Glass Company, Toledo, Ohio. (Personal communication, 1954.)
6. Shuster, Herbert V., and Lockhardt, Ernest E. Development and application of objective methods for quality evaluation of spices. I. Color-grading of capsicums. *Food Research*, 19, 472 (1954).

Dehydrated Blue Lake Green Beans[a, b]

Earl M. Litwiller and L. A. Pettit [c]

(Manuscript received November 10, 1956)

Earlier efforts to produce dehydrated beans which reconstitute to yield a product comparable with canned beans were not particularly successful *(2, 9)*. Thus, in 1951, when the request came to Oregon State College from the Quartermaster Food and Container Institute for the Armed Forces, to work toward the development of a more satisfactory dehydrated green bean, there was no assurance that such a product was possible. But early during the preliminary trials of that year a treatment was used which proved to be the factor which made possible the success of this undertaking.

Any dehydrated food to be acceptable must, when reconstituted, possess a desirable appearance, texture, and flavor *(5, 10)*. In addition to meeting these requirements, military considerations require that dehydrated foods maintain such characteristics to a reasonable degree for at least 6 months when stored at 100° F. In this investigation, it was found that prefreezing the beans enabled the attainment of lower than normal moisture levels, and at the same time improved rehydration characteristics.

The work reported here covers a period of 2 years. The basic method of dehydration was developed during the first year. Improvements in application and further testing during the second year, broadened and confirmed the first year's findings.

EXPERIMENTAL PROCEDURES

Preliminary trials showed that bean sizes numbers one and two were too small to reconstitute satisfactorily after dehydration. Therefore, in all subsequent tests the beans were graded and only sizes three, four, and five were used. After snipping, the beans were cut into half-inch lengths. All lots were blanched in steam, either for 4 or 6 minutes. Preliminary experiments had shown a 4-minute blanch was adequate to inactivate peroxidase, but it was desired to determine if a longer blanch would affect the rehydration. Certain lots of the blanched beans were then dipped for 5 minutes into a 1,000 or 3,000 p.p.m. sulfite solution prepared from sodium metabisulfite and frozen at 0° F. or —20° F.

Dehydration was effected after some preliminary trial runs, by placing the prepared beans, 3,000 g. per tray, into a cabinet type recirculating drier with the dry bulb temperature at 190° F. The load of cold beans quickly lowered this temperature until after about one hour it was possible to hold it at 145° F. where it was maintained until the end of the drying cycle. Six to 6½ hours were required for drying. The dehydrated beans were then removed from the trays and placed into a bin drier and held 48 hours at 115° F. in order that their moisture content would be equalized. All the beans were subjected to this drying regimen. As shown in Table 1, an average moisture level as low as 2.07% was achieved with beans which were blanched, sulfited at a 3,000 p.p.m. level and frozen at 0° F. The average moisture content for the blanched unsulfited and unfrozen beans was 4.53%. Table 1 further shows that the final moistures for all the treatments of unfrozen beans averaged much higher than for the frozen beans.

During the first year's trials the dehydrated beans were divided into lots, sealed in metal cans under vacuum and in atmospheres of air and nitrogen. These cans were then stored at 72° F. and 100° F. Because visual observations (of color) and rehydration tests showed no marked effects arising from differences in atmospheres, during the second year the vacuum and nitrogen packs were omitted.

The stored beans at intervals of 2, 4 and 6 months were subjected to a number of tests and analyses. These included rehydration, sulfite determinations, tests for peroxidase activity and appraisals of texture, appearance and flavor.

Dehydration ratios were computed by dividing the undried weight of each lot by its finished weight (after bin drying).

The method adopted for rehydration was determined by a series of preliminary cooking trials from which an optimum uniform procedure was developed and used for all samples. Twenty grams of dehydrated beans were placed into 1,200 ml. of hot tap water in an open pyrex pan. This pan, without a cover, was placed over a gas burner and brought quickly to a boil. The elapsed time from the immersion of the beans in water to the start of boiling was 6½ to 7 minutes. The beans were boiled rapidly for 10 minutes, after which the gas flame was reduced to produce moderate boiling for an additional 25 minutes. The beans were weighed after draining on an 8-mesh to the inch screen for one minute.

Rehydration ratios were computed by multiplying the weight of the dry sample by its dehydration ratio. This figure represents 100% reconstitution. Then the actual weight of the drained reconstituted sample multiplied by 100 and divided by the above calculated weight constituted the percent rehydration.

Sulfite determinations were made by the method of Potter and Hendel *(11)* in which ground weighed samples of beans were soaked two minutes in a 5N sodium hydroxide solution

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[a] Technical Paper No. 1008, Oregon Agricultural Experiment Station. Contribution of the Food Technology Department.

[b] This paper reports research undertaken in cooperation with the Quartermaster Food and Container Institute for the Armed Forces, and has been assigned number 609 in the series of papers approved for publication. The views or conclusions contained in this report are those of the authors. They are not to be construed as necessarily reflecting the views or indorsement of the Department of Defense.

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TABLE 1

Effects of pretreatments on dehydration ratios, moisture levels, percent rehydration, flavor, tenderness and texture for size four dehydrated Blue Lake (Associated 231) green beans

Pretreatment[1]	Dehydration ratio	Percent moisture in dried beans	Percent rehydration						Average flavor score[2]		Texture by panel		Shearing pressure in pounds
			72° F.		Storage	100° F.							
			2 months	4 months	6 months	2 months	4 months	6 months	2 months	4 months	2 months	4 months	
Blanched	9.93	4.53	57.42	59.0	54.87	55.10	53.92	52.60	....	....	....	....	180.0
Blanched, frozen at —20° F.	10.80	2.54	67.67	70.05	70.10	63.35	58.32	57.05	6.3	5.7	6.2	5.4	136.5
Blanched, frozen at 0° F.	10.37	2.35	86.90	83.07	84.85	82.07	78.97	75.12	6.7	7.6	6.9	7.4	105.0
Blanched, sulfited at 1000 p.p.m.	10.89	4.14	57.17	55.52	54.02	53.72	51.90	51.97	....	....	....	....	181.5
Blanched, sulfited at 3000 p.p.m.	11.63	4.35	59.20	59.70	58.60	56.75	55.79	52.47	....	....	....	....	121.5
Blanched, sulfited at 1000 p.p.m., frozen at —20° F.	10.83	2.77	83.10	83.57	81.37	73.72	64.20	63.22	6.3	6.1	6.3	5.9	123.0
Blanched, sulfited at 3000 p.p.m., frozen at —20° F.	11.54	2.53	81.20	82.97	84.72	81.20	82.97	84.72	6.6	6.4	6.2	6.0	94.5
Blanched, sulfited at 1000 p.p.m., frozen at 0° F.	10.81	2.57	93.22	88.12	88.92	85.75	78.62	76.95	7.3	7.4	7.0	7.2	
Blanched, sulfited at 3000 p.p.m., frozen at 0° F.	11.50	2.07	92.25	88.12	91.60	88.65	86.40	83.37	5.7	6.5	6.1	6.9	

[1] A uniform blanching time of four minutes in steam was used for all the above samples.

[2] A score of 5 is *acceptable*, 6 is *fairly good* and 7 is *good* on the flavor acceptance scale used. None of the unfrozen beans were tasted since they appeared wholly unacceptable.

after which they were acidified and titrated with standard iodine.

The presence or absence of peroxidase was shown by use of the guaiacol hydrogen peroxide test. A small amount of dried beans were ground and placed into a Waring blender. One hundred to 150 ml. of water were added and the mixture was blended 2 minutes. To an aliquot of the mixture were then added 10 drops of 3% hydrogen peroxide and 10 drops of a 0.5% alcoholic solution of guaiacol. The development of a reddish-brown color within 3 minutes was regarded as a positive test.

Moistures were determined on accurately weighed, triplicated portions of dehydrated beans which had been ground to pass through a 20-mesh to the inch screen and placed into a vacuum oven. The temperature was held at 140° F. and drying continued until the samples attained constant weight. The moisture was then calculated on the loss of weight.

An estimation of flavor and texture acceptability was obtained by presenting small samples of cooked rehydrated beans from each treatment to a taste test panel of 8 to 10 experienced tasters. These tasters consisted of staff and graduate students of the Department of Food Technology, Oregon State College. The tasters recorded their judgments of acceptability on a printed ballot with a 10-point scale in which 0 denoted *unacceptable* and 9 *superior*. Texture measurements were made, using the Maryland Shear Press.

RESULTS AND DISCUSSION

Dehydration ratio: Where a total of 595 pounds of fresh beans were dehydrated to a finished weight of 55 pounds, an average dehydration ratio of 10.8:1 (fresh basis) was realized.

Rehydration: While there was considerable variation in the extent to which different lots of beans reconstituted, all lots which were prefrozen showed consistently higher rehydration values, averaging 20 to 30% more than the unfrozen. Table 1 shows that after 2 months' storage an average of 90.5% reconstitution was attained for beans which were blanched, sulfited at 3,000 p.p.m. and frozen at 0° F., whereas those which were blanched, but neither sulfited nor frozen, yielded an average of only 56.3% rehydration.

Table 2 shows for two storage temperatures that, for both unsulfited and sulfited beans, freezing at 0° F. and —20° F. greatly increased the percent of rehydration over that for the unfrozen beans. For instance, unfrozen and unsulfited beans stored at 100° F. showed a rehydration of 52.6%, while for those which were sulfited at 3,000 p.p.m. and frozen at 0° F. and —20° F. the percentages were 83.4% and 63.4% respectively. Table 3 shows, when an average of both sulfited and unsulfited lots was considered, increased storage temperatures resulted in a lowering of the percent of rehydration for both the unfrozen and frozen beans. After 4 months' storage at 72° F. the unfrozen beans showed 58.1% rehydration and 53.9% at 100° F. Those frozen at 0° F. likewise showed 86.4% and 81.3%, respectively.

After 6 months of storage at 72° F. and 100° F. it was observed that the percent of rehydration was not affected by a difference in blanching time.

Moisture: As shown by Table 1, the average moisture levels for dehydrated Blue Lake beans frozen preceding

TABLE 2

Effect of freezing and sulfiting before dehydration on the percent rehydration of Blue Lake beans (Associated 231) after six months' storage at 72° F. and 100° F.

Treatment	Unfrozen		Frozen at —20° F.		Frozen at 0° F.	
	72° F.	100° F.	72° F.	100° F.	72° F.	100° F.
No sulfite	54.9	52.6	70.1	57.0	84.8	75.1
1,000 p.p.m. sulfite	54.0	52.0	81.4	63.2	89.9	76.9
3,000 p.p.m. sulfite	58.6	52.5	84.7	63.3	91.6	83.4

TABLE 3

Effects of storage temperatures on the percent rehydration of Blue Lake (Associate 231) dehydrated green beans

Pretreatments	2 months' storage		4 months' storage	
	72° F.	100° F.	72° F.	100° F.
Unfrozen dehydrated, average of sulfited and non-sulfited lots	57.6	55.5	58.1	53.9
Frozen at —20° F. average of sulfited and non-sulfited lots	78.1	75.3	79.0	63.2
Frozen at 0° F. average of sulfited and non-sulfited lots	91.2	87.7	86.4	81.3

dehydration was 2.47%, while for the unfrozen of the same variety it was 4.67%. Since beans produced by the freezing method keep better in storage than the unfrozen, it would appear that the lowered moisture level might be responsible.

Peroxidase: Tests for peroxidase were negative for beans which were blanched 4 minutes, indicating adequate blanching.

Sulfite: As is indicated in Table 4, in general the sulfite levels of the beans dipped in solutions containing

TABLE 4

Mean sulfite residues in Blue Lake beans in parts per million after two months' storage at 72° F. and 100° F.

Pretreatment by dipping five minutes in sulfite solution of	Frozen at 0° F. Storage temperatures		Frozen at —20° F. Storage temperatures	
	72° F.	100° F.	72° F.	100° F.
1,000 p.p.m.	404	470	312	77
3,000 p.p.m.	2,100	1,487	1,448	1,235

either 1,000 p.p.m. or 3,000 p.p.m. of sulfur dioxide after 2 months were lower at 100° F. storage temperature than at 72° F. The work of others *(7, 12)* shows that losses in sulfite increase progressively the longer sulfited fruits remain in storage. However, except for prolonged storage, the 3,000 p.p.m. dip would be undesirable because of the apparent softening effect of the sulfite on the bean tissues as indicated in Table 1 by the lower shearing pressures for the beans receiving the greater amounts of sulfite.

General appearance and color: Non-sulfilted beans appeared less attractive than the sulfited whether prefrozen or not. Sulfiting at 3,000 p.p.m. was effective in maintaining good color even at 100° F. storage, but at this temperature there was progressive deterioration in general appearance even at the 1,000 p.p.m. sulfite level. The appearance of the cooked beans is closely related to the degree of wrinkling, a reflection of the extent of rehydration. All of the unfrozen samples appeared excessively wrinkled and quite unattractive.

SUMMARY AND CONCLUSIONS

Prefreezing is essential to our dehydration process since it lowers the final moisture level of the dried beans, increases the percent of rehydration at least 20% if stored at normal temperatures and greatly improves the appearance and acceptability of the product. Since it results in significantly higher percentages of rehydration than —20° F., 0° F. is preferred as the freezing temperature. Moreover, higher taste test panel scores for flavor and texture were generally accorded beans frozen at 0° F. than at —20° F.

Sulfiting at 1,000 p.p.m. increases the percent of rehydration and aids materially in maintaining flavor and appearance in the rehydrated product, 3,000 p.p.m. sulfite dipping treatment results in objectionable sulfite residues and a tendency toward excessive softness of the reconstituted beans.

A 4-minute steam blanch is sufficient for enzyme inactivation and appears to be a satisfactory time and method.

Bean grade sizes 4 and 5 yield a good rehydrated product both as to appearance and quality. Previous experience indicates smaller sizes rehydrate poorly while sizes 6 or larger, although they may be somewhat fibrous, rehydrate well and yield a product generally superior in flavor to the smaller sizes. Cooking without a previous soaking is recommended for rehydration.

Storage at 100° F. causes some reduction in the percent of rehydration and some loss of green color. To our tasters, the prefrozen sulfited dehydrated beans when stored at 100° F. were acceptable after 6 months' storage.

Blue Lake beans are suitable for producing satisfactory dehydrated green beans. We believe many varieties can be so used as evidenced by limited work conducted on bush beans in connection with this investigation.

From the results obtained by our taste test panel and from other persons asked to test the beans dehydrated by our method, sizes 4 and 5 were shown to be of high quality, provided they did not contain excessive amounts of sulfite, and to be as acceptable as certain other forms of processed beans. Because these beans afford substantial savings in weight and bulk, they offer special advantages for use by the Armed Forces. Since these beans are an attractive and nutritious food, we believe they also possess definite values for civilian use.

LITERATURE CITED

1. Caldwell, J. S., and Culpepper, C. V. Snap bean varieties suited to dehydration. *Food Packer,* **24**, 309-313, 363-364, 366, 368, 420, 422-423 (1943).
2. Caldwell, J. S., and Associates. Further studies of varietal suitability for dehydration in snap beans. *Canner,* **99**, 13-15, 22 (July 29, 1944), **99**, 12-15, 30 (Aug. 5, 1944), **99**, 16-18, 30 (Aug. 12, 1944), **99**, 17-18, 38, 40 (Aug. 19, 1944).
3. Cruess, W. V., Friar, H. F., and Balog, E. The dehydration of snap beans. *Canner,* **97**, 18-20 (June 5, 1943).
4. Dawson, Elsie H., Lamb, Jessie C., and Toepfer, H. W. W. Development of rapid methods of soaking and cooking dry beans. U. S. Department of Agriculture *Tech. Bull.* 1051 (1952).
5. Holmes, Alyce H. The reconstitution characteristics of snap bean varieties with some ascorbic acid values. (M.S. thesis, Corvallis, Oregon State College, 1945).
6. Lee, F. S., Gortner, W. A., and Withycombe, Joanne. Effect of freezing rate on vegetables—appearance, palatability, and vitamin content of peas and snap beans. *Ind. Eng. Chem.,* **38**, 341-346 (1946).
7. MacKinney, G. The sulfiting of vegetables. *Fruit Products J.,* **24**, 300-301 (1945).
8. MacKinney, G., Friar, H. F., and Balog, E. Sulfured dehydrated vegetables. *Fruit Products J.,* **22**, 294, 315 (1943).
9. Moyer, J. C., and Associates. Varietal adaptability of New York vegetables to dehydration. *Canner,* **97**, 15-18, 26 (Aug. 7, 1943).
10. Mrak, E. M. Developments in dehydration. *J. Dietet. Assoc.,* **19**, 6-12 (1943).
11. Potter, E. F., and Hendel, C. E. Determination of sulfite in dehydrated white potatoes by direct titration. *Food Technol.,* **5**, 473-475 (1951).
12. Sorber, D. G. The relation of the sulfur dioxide and total sulfur contents of dried apricots to color change during storage. *Fruit Products J.,* **23**, 234-237 (1943).
13. Spinella, Jane R., French, C. E., and Berryman, C. H. Improvement in the method of cooking certain dehydrated foods. *J. Am. Dietet. Assoc.,* **21**, 148-150 (1952).
14. Stillman, J. F., Watts, B. M., and Morgan, A. F. Palatability studies on home dehydrated vegetables. *J. Home Econ.,* **36**, 28-34 (1944).
15. U. S. War Department. *Cooking Dehydrated Foods.* TM10-406. Washington, D. C. (1943).

Dried Prune Products—Some Factors Which Influence Their Corrosivity[a]

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FOR MANY YEARS it has been recognized that dried prunes in syrup is one of the most corrosive foods packed in cans. It was reported in a technical paper over 20 years ago *(5)* that the widespread occurrence of springers and perforations had very greatly restricted commercial packing. Since that time considerable research in which the American Can Co. participated *(1, 2)* has been carried out, with the result that improved can making materials have been developed. This in turn has made the commercial canning of dried prune products much more feasible.

The fact remains, however, that dried prunes are strongly corrosive. In addition, considerable variation in service life of packs has been observed.

A number of investigations of the corrosivity of dried prunes has been made in the past. Kohman and Sanborn *(5)* obtained data showing that dehydration made prunes more corrosive than the fresh fruit. In another test, however, a puree made from the fresh fruit was quite corrosive. Additional work reported by Mrak and Richert *(7)* and Mrak and Cruess *(6)* showed that no relation existed between growing location or variety of prunes with corrosiveness. Sun drying did not result in a different corrosion level than dehydrating. It was found that certain optimum conditions of blanch and fill were advantageous in maintaining service life, as was also the addition of citric acid.

The present studies were designed to evaluate the effects of the following factors on the corrosivity of dried prune products:

Variations in the time and temperature of dehydration.

Effect of storage of the dried prunes at several temperatures.

Variations in the procedure of leaching to make prune juice.

Concurrently with the test packs to study the influence of the above factors on shelf life, a series of investigations was undertaken to find a method of estimating corrosivity quickly and, in turn, probable shelf life of dried prune products in plain tinplate containers.

MATERIALS AND METHODS

Dried prunes. Approximately 16,000 pounds of field-run prunes were obtained for these tests. A portion of this fruit was taken in its original condition, the remainder being processed in a commercial dehydrator for varying lengths of time and the resultant lots with varying moisture levels placed in 30-pound slip-covered cans for storage. One lot having 26% moisture, which was considered to be almost fully dehydrated, was further divided into 2 parts, one of which was treated with propylene oxide (1 ml. per pound of dried prunes) to prevent possible mold growth. The lot selected as representing normal fully dehydrated fruit measured 23% moisture.

Fruit to be used in later test packs was stored in non-hermetic 30-pound slip-covered containers at 3 temperatures, 40°, 70°, and 85° F. (4.4°, 21.1°, and 29.4° C.). Actually, the temperatures obtained in the last 2 lots did not average 15° F. apart since during part of the year the room temperature was above 70° F., and the 85° F. lots were removed several times to room temperature. Performance of these 2 lots was therefore understandably similar.

Cans. For the evaluation of corrosivity of the different lots of fruit, packs were made both as prunes in water and as single strength prune juice. One large lot of plain 307 x 409 (No. 2) cans was made so that the same cans would be used throughout the test. They were made of No. 50 electrolytic tinplate (0.50 lb. per base box) rather than the conventional Standard Cokes (1.50 lb. per base box) in order to obtain accelerated results.

Canning. In packing the prunes in water it was decided to use the same count of fruit in each can so that the total solids would be uniform regardless of the degree of dehydration of various lots. A count of 24 prunes per can was used since this represented the optimum fill of the fresh fruit. Boiling water was added to the cans of prunes, the cans steam exhausted at 210° F. (98.9° C.) for 15 minutes, and the tops double seamed. For later analysis, prunes were also packed in glass jars, 19 count per 303 jar, filled with water, and exhausted with the cans, after which the caps were assembled. Both cans and jars were processed in boiling water for 25 minutes. Jars were air cooled and cans were water cooled.

In making prune juice the weight of prunes used was adjusted for the moisture level of the various lots; 43 pounds of the fully dehydrated, 23% moisture prunes was used. The standard procedure called for successive leaches using 10 gallons of water for the first and 5 gallons for the other three. The leachings were 5, 4½, 4, and 3 hours, respectively. Temperature was held at about 190° F. (87.8° C.) during leaching and the stainless steel kettles kept covered to minimize evaporation. Concentration and pH were measured on each leaching. Leachings were then combined, concentrated by boiling to about 20° Brix and filtered through two layers of cheese cloth. Cans were filled with the juice at 200-205° F. (93.3-96.1° C.), double-seamed, inverted and held for 3 minutes, and then water cooled. Glass jars were filled at the same temperature, closed, processed for 25 minutes in boiling water and air cooled. Between 20 and 40 cans per lot were packed.

Distilled water was used to avoid differences in water supply at the two laboratories where the packs were made.

Cans were stored at room temperature for periodic flip testing to determine the rate of vacuum loss due to internal corrosion. A can is considered to have failed when one or both ends become permanently convex due to hydrogen gas formation. The shelf life reported below is the time elapsed until half the cans in a particular lot failed.

Optical density. Measurements of optical density were made in order to have quantitative figures of the obvious color differences. Since no absorption maxima or minima were observed in the visible range a convenient wave length of 450 mμ was taken for making the optical density readings. Using the method of Honsberger *(4)* for determining caramel in dried prunes, diluted juices were clarified with diatomaceous earth and then freed of pectin by alkaline hydrolysis followed by acidification, filtration, and pH adjustment to 4.5 before measurement of optical density. Although dried fruit color may be due to a number of different compounds, this measurement was referred to as a caramel determination and comparison was made to a concentration—optical density curve for an arbitrarily chosen commercial caramel. It was later found that almost identical results could be obtained by simply diluting the juice 1 to 50 and running it directly.

[a] Presented at the Sixteenth Annual Meeting of the Institute of Food Technologists, June 10-14, 1956, St. Louis, Missouri.

Prune juices and syrups show an absorption maximum at 284 mμ in the ultra-violet range. Optical densities measured on 1 to 2000 dilutions at this wave length were also determined.

Corrosion cell studies. Studies were made using coupled and uncoupled 4 sq. in. discs of tinplate steel and pure block tin in all of these juices and syrups. Spools of the weighed metals were placed in fully enameled cans and covered with juice heated to 200° F. (93.3° C.). The completely filled cans were closed and quickly cooled to 100° F. (37.8° C.), at which temperature they were held for various periods of time. After opening, the metals were checked for weight loss. Although some differences for both uncoupled and coupled steel were noted between known corrosive and non-corrosive prune products, it soon became apparent that the most significant differences occurred with uncoupled tin. The tests were then repeated using only uncoupled tin on the spools. Test duration was 10 days at 100° F. (37.8° C.).

RESULTS

Effect of dehydration. Shelf life data obtained from the first series of test packs are shown in Figure 1. Prunes given successively stronger dehydration exhibit increasing corrosiveness

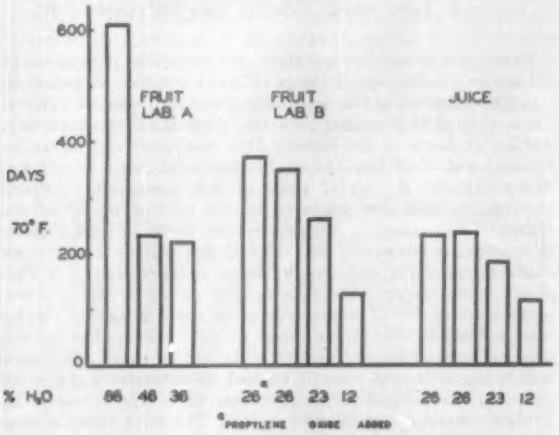

Figure 1. Effect of dehydration on service life.

and shorter shelf life. The first 3 lots were packed at one laboratory, the rest at a second; a definite break in the data occurs between them even though the same nominal packing procedure was used.

Juice made from the last 4 lots of prunes showed the same decrease of shelf life with increased dehydration. Original plans called for juice to be made from all lots but it was decided that juice made from prunes with a higher moisture content would not be representative of commercial juice. The 12% moisture fruit included in Figure 1 was prepared by heating 23% prunes in an oven at 190° F. (87.8° C.) for 7 hours, and is considered to be a severely dehydrated lot.

A portion of the fully dehydrated 23% moisture prunes was later used for some additional drying tests, as shown in Figure 2. It is noticed that 10 hours at 165° F. (73.9° C.), even though

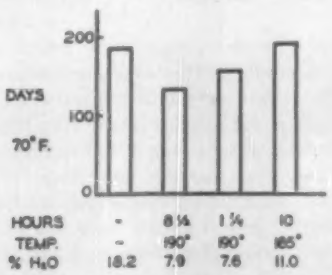

Figure 2. Additional dehydration of prunes (prune juice).

removing considerable moisture, did not result in increased corrosiveness of the juice. Treatment at 190° F. (87.8° C.) for both 1¼ and 8½ hours resulted in about the same final moisture level but higher corrosivity is evident from the longer time. This suggests that chemical changes brought on as the result of heating are the more important factor in corrosivity than mere removal of water.

Propylene oxide apparently has no effect on shelf life.

Effect of storage. Packs were also made of prunes in water after 1½ years' and 4 years' storage of the dried fruit with results as shown in Figure 3. Both the nearly fully dehydrated

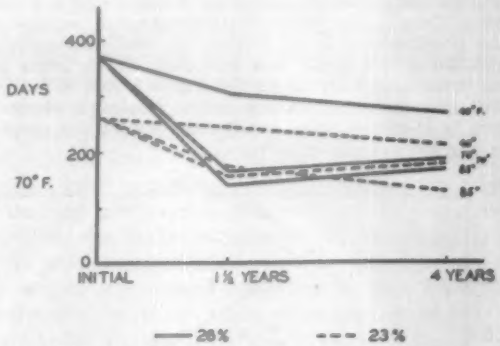

Figure 3. Effect of storage of dried prunes.

lot with added propylene oxide, and the 23% moisture prunes were used. Fruit stored at 40° F. (4.4° C.) has shown a slow but gradual increase in corrosivity during this period. All the lots at higher temperatures, however, reached about the same increased corrosivity after 1½ years' storage with no consistent change taking place between 1½ and 4 years' storage. It seems that the effect of 1½ years at these temperatures is sufficient to render both lots of prunes equally corrosive.

Juice was made and packed at the 1½ year period for comparison with the packs of prunes in water. Shelf life data are shown in Figure 4. The corrosive tendency of the juice follows that of the prunes.

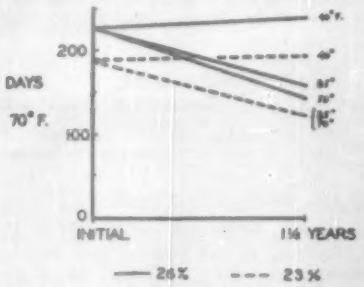

Figure 4. Effect of storage of dried prunes (prune juice).

Effect of leaching variables. The various lots of prune juice mentioned above were made using a commonly accepted procedure. After leaching the prunes in successive quantities of water at controlled temperature and time, the resulting leach portions were combined and boiled down to the desired concentration. In one test a juice was made from the combined first and second leachings only, another from the third and fourth; a juice made from all 4 leaches served as a control. It was found that juice made from the combined third and fourth leachings was more corrosive by about 30% than juice from the first 2 leachings. The juice made as usual from all leaches was about midway in corrosiveness between these values.

This experiment was subsequently repeated using a new source of prunes but no difference in corrosivity between leaches was observed.

Using again this new source of prunes, juice was prepared by vacuum concentration of the leachings compared with concentration by boiling in an open kettle. No difference in shelf life resulted. The juice made in these last two experiments, however, had a shelf life about 50% greater than that made from the prunes used in the remainder of the program.

The temperature at which the leaching is carried out was also investigated; there was no difference in corrosivity of juices leached at 165° F. and 190° F. (73.9° C. and 87.8° C.); leaching at temperatures of 205-210° F. (96.1-98.9° C.) caused about a 20% reduction in service life.

Rapid estimation of corrosivity. Optical densities of the syrups and juices diluted 1 to 50 are shown in Table 1 under "Visible Color". The effect of temperature of storage and degree of dehydration on this property are clearly demonstrated. Correlation of this optical data with pack life for juices prepared immediately after drying the fruit and after it had been stored at various temperatures for 1½ years is shown in Figure 5. It appears quite certain that the color of a prepared juice is a fair index of its corrosivity.

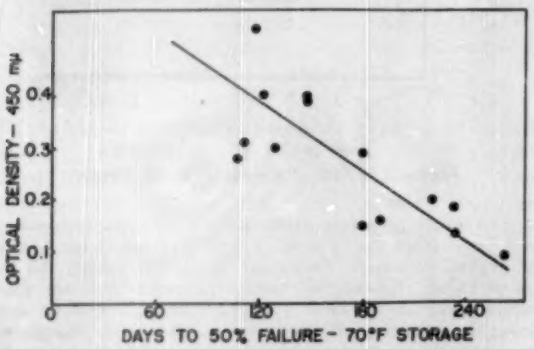

Figure 5. Correlation of optical data with pack life for juices.

Behavior of the canned fruit was somewhat more erratic than the juice. Color versus pack life data for the fruit packs are shown in Figure 6. Densities of the most corrosive fruits packed at 1½ years are less than those of the corresponding juices whereas the densities of the prunes stored for 4 years are greater than those of the juices. The difference may have been due to variation in packing procedure although nominally it was the same. Possibly factors other than that associated with color are of the most significance. However, with all of the data in Figures 5 and 6 plotted together a correlation of color and pack life is still obvious.

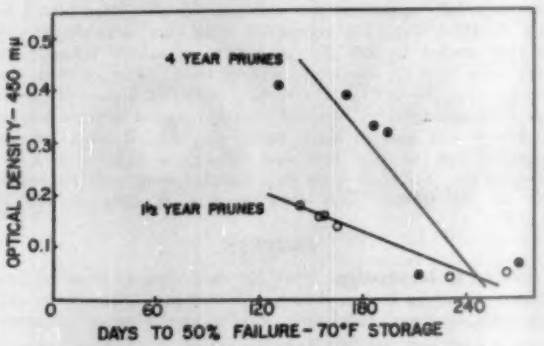

Figure 6. Color versus pack life data for canned fruit.

Prune juices and syrups show an absorption maximum at 284 mμ in the ultra-violet range. Optical densities measured on 1 to 2000 dilutions at this wave length are also listed in Table 1. These data plotted against pack life show about the same correlation as found in the visible. This maximum was shown by Proctor and Goldblith *(8)* to be associated with 5-hydroxymethylfurfural. A careful study of this compound, extracted from prunes and also prepared by the method of Jones and Haworth *(3)*, added to mildly corrosive fruits in pack tests or in appropriate laboratory tests showed that neither it nor its air oxidation products had any influence on corrosivity. A corrosive juice having an optical density of .35 at 284 mμ was extracted cold for 27 hours with ether until its optical density was reduced to .14, in the range of mild juices. During this time no color change occcurred in the visible range. Corrosion weight loss tests with pure tin showed the extracted and original juices to have almost identical corrosivities. The corrosive ingredient obviously is not ether soluble. The ultra violet absorption method does not, therefore, measure the corrosive ingredient but one arising simultaneously with it.

Corrosion cells using uncoupled tin on the spools were run

TABLE 1

Summary of several quantitative tests on the nature of dried prune products

Product		Storage temp.	Shelf life days to 50% failure			Visible (450 mμ) optical density			U. V. (284 mμ) optical density			Tin wt. loss 10 days—mg.			Polarograph ½ wave ht.
		° F.	0	1½	4 yrs.	0	1½	4 yrs.	0	1½	4 yrs.	0	1½	4 yrs.	1½ yrs.
Fruit—26% H_2O		40	369	296	271	.05	.05	.07	—	.04	.07	—	3.1	2.5	—
		70	—	159	194	—	.16	.32	—	.08	.17	—	6.4	8.5	—
		85	—	143	170	—	.18	.39	—	.08	.19	—	8.1	11.6	—
Fruit—23% H_2O		40	256	230	213	.04	.04	.05	—	.03	.06	—	2.7	2.1	2.0
		70	—	155	186	—	.16	.33	—	.09	.10	—	6.7	9.9	11.6
		85	—	165	131	—	.14	.41	—	.08	.23	—	7.8	10.8	—
Juice—26% H_2O		40	233	235	—	.13	.18	—	—	.12	—	—	4.8	—	—
		70	—	133	—	—	.30	—	—	.20	—	—	6.8	—	—
		85	—	148	—	—	.40	—	—	.27	—	—	8.6	—	—
Juice—23% H_2O		40	191	181	—	.16	.15	—	—	.12	—	—	4.9	—	16.4
		70	—	108	—	—	.28	—	—	.26	—	—	7.4	—	30.0
		85	—	112	—	—	.31	—	—	.24	—	—	8.1	—	—
Juice—23% H_2O	a	40	123	118	—	.40	.53	—	—	.37	—	—	10.2	—	41.0
	b	40	—	148	—	—	.39	—	—	.28	—	—	9.4	—	36.5
	c	40	—	181	—	—	.29	—	—	.25	—	—	7.8	—	34.0
Juice—New Lot	d	—	—	311	—	—	.09	—	—	.04	—	—	2.8	—	4.7
	e	—	—	247	—	—	.20	—	—	.09	—	—	4.4	—	14.6

Legend: a = 8½ hr. @ 190° F.
b = 1½ hr. @ 190° F.
c = 10 hr. @ 165° F.
d = 165° F. leach.
e = 205-210° F. leach.

for 10 days at 100° F. (37.8° C.) with the tin weight losses as shown in Table 1. Good correlation with pack life results for the pack made after 1½ years storage is shown in Figure 7. Both fruit and juice fell into the same general range, thus showing a little better correlation than with the color determinations. The tin weight loss method could therefore be used to predict prune corrosivity. This fits with the general observation that dried prunes are detinners. If the container steel is normal and the product not contaminated with any substance known to reverse the tin-iron couple relationship (in which tin is anodic), dried prune products in plain cans fail mainly because of detinning due to straight chemical attack on the tin followed by rapid attack of the exposed steel. To a lesser extent, failure is due to the electro-chemical force between tin and iron. It seems clear that the early failures arising in the present experiment related to excessive dehydration and extended storage are primarily caused by increased chemical attack directly on the tin.

Treatment of dried prune juices with dichlorophenolindophenol followed by xylene extraction reveals the presence of ascorbic acid-like materials although fresh prunes have practically no ascorbic acid. The more corrosive juices showed up to 10 mg./100 g. of reducing substance calculated as ascorbic acid while the milder juices exhibited amounts in proportion to corrosivity. Attempts to recognize oxidizing constituents by polarography failed. Only reducing substances could be detected. The half wave heights at pH 7.0 obtained in the various juices correlated inversely with pack life showing a degree of scatter about like that in Figure 7 for tin weight loss.

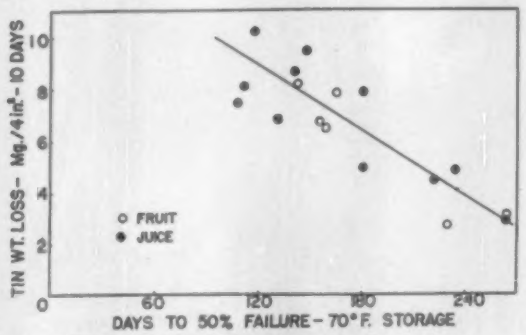

Figure 7. Tin weight loss versus pack life.

DISCUSSION

It has been shown that the corrosivity of prunes increases greatly during dehydration. That the change is due to chemical alteration within the fruit is pointed up by tests in which different heat treatments which result in the same moisture content change the corrosivity.

Even after dehydration, prunes in storage (unless held in cold storage) continue to become more corrosive at a fairly fast rate. The two lots of prunes used in these studies had reached their maximum corrosivity within 1½ years' time at ordinary warehouse temperatures.

It was found that optical density measurements showed a correlation with corrosiveness of prune packs, particularly during the first year and a half of storage. After the end of 4 years' storage the optical density had shown a continued change—which, however, was not reflected in increased corrosivity. Analytical tests showed that the ingredient responsible for the absorption peak in the ultra violet range, 5-hydroxymethylfurfural, was not a corrosive substance. But, apparently, its increase during dehydration and the earlier portion of storage time paralleled the unknown ingredient responsible for the increase in corrosivity.

Juice made from the third and fourth leachings was found to be more corrosive than that made up to the same solids level but from the first two leachings. This is possibly an indication that the more corrosive substances are in the region of the pit and require longer to diffuse through the flesh and into the leaching water. An earlier investigation also furnished data suggesting that the pits tended to accelerate corrosion *(5)*. On the other hand it may be that the substances leached out later have been made more corrosive as a result of the heat absorbed during leaching.

A new supply of prunes was obtained for several tests of leaching variables; juice made from this lot of fruit had a much longer shelf life than that made from the original lot of prunes, and the new fruit did not respond to leaching treatment as had the first. This occurrence bears out the earlier statement that variability is one of the phenomena of dried prunes. Optical density and tin weight loss values measured on this juice were comparable to those made from prunes stored 1½ years at 40° F. (4.4° C.).

SUMMARY

Corrosiveness of dried prunes increases with the severity of dehydration. Storage of dried prunes at normal temperatures increases thir corrosivity. This change is reduced by the use of cold storage. First leachings produce a juice less corrosive than that from subsequent leaches; leaching at close to boiling temperatures makes a somewhat more corrosive juice than leaching at lower temperatures.

An indication of the expected shelf life of prune juice may be obtained by measuring optical density either in the visible or ultra violet range, or tin weight loss in a corrosion cell.

Acknowledgment

The authors appreciate the assistance provided by Mr. E. L. Mitchell of Richmond Chase Co., San Jose, Calif., in planning and carrying out certain phases of this program.

LITERATURE CITED

1. Clark, B. S., and Brighton, K. W. Better base plate for better food cans. *Modern Packaging*, 19 (3), 168 (1946).
2. Hartwell, R. R. Corrosion factors related to the use of tinplate for food containers. *Food Technol.*, 5, 402 (1951).
3. Haworth, W. N., and Jones, W. G. M. Conversion of sucrose into furan compounds. I. 5-hydroxy-methylfurfuraldehyde and some derivatives. *J. Chem. Soc.*, 667 (1944).
4. Honsberger, L. P. (Private communication, Feb. 9, 1949).
5. Kohman, E. F., and Sanborn, N. H. Increased acidity inhibits corrosion. *Ind. Eng. Chem.*, 25, 8 (1933).
6. Mrak, E. M., and Cruess, W. V. Utilization of surplus prunes. U. of Cal. Agr. Exp. Station *Bull. 483* (1929).
7. Mrak, E. M., and Richert, P. H. The swelling of canned prunes. U. of Cal. Agr. Exp. Station *Bull. 483* (1931).
8. Proctor, B. E., and Goldblith, S. A. Effect of supervoltage cathode rays on the nonenzymic browning reaction of dried fruits and on chemical compounds pertaining thereto. *Science*, 109 (2838) 519 (1949).

Advances in the Dehydration of Mashed Potatoes by the Flake Process[a]

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(Manuscript received October 17, 1956)

POTATO FLAKES are a recently developed new and attractive form of dehydrated mashed potatoes. When reconstituted, they produce mashed potatoes of excellent texture, appearance, color, and flavor. Earlier papers have described the process as originally developed using a small double-drum drier *(1, 5)*, the factors controlling texture of the reconstituted mash and permitting the use of low-solids content potatoes *(2)*, and the estimated cost of commercial production based on more recent work with a larger, single-drum drier *(3, 4)*.

Data reported in this paper were obtained by operation of a larger, integrated pilot plant, embodying the predrying steps developed for texture control in earlier work, and employing a single-drum drier for the dehydration. The larger plant was required to obtain reliable data for estimation of commercial production costs and to produce large quantities of potato flakes from many varieties of potatoes for evaluation. A single-drum, rather than a double-drum, drier was chosen because of indications that it could produce a denser flake that would be less costly to package. Further, single-drum driers formerly used for potato flour manufacture are idle in some plants and are available for use in potato flake manufacture.

EXPERIMENTAL

Process and equipment. A flow sheet of the pilot-plant process is shown in Figure 1. Potatoes were peeled either by abrasion or by treatment with lye of 30° Be. (about 24% NaOH) at 150° F. (65° C.) for 4 minutes. They were hand-trimmed to remove blemishes and eyes, sliced into 5/16-inch thick slabs from which the surface starch was washed, and then precooked in water at a temperature of 165° F. (74° C.) for 20 minutes. Precooking gelatinizes the starch before the final cooking step, improves the texture of the reconstituted product, and permits the use of low-solids content potatoes *(2)*. In the pilot plant, the precooking operation was performed as pictured in Figure 2. Potato slices were weighed into tinned wire baskets, which were placed into the hot water tank at intervals and moved along at a rate to give 20 minutes precooking. Baskets were removed from the precooker and the slices were spread 2 to 3 inches deep on the stainless steel wire mesh belt of a continuous steam cooker. (Robins No. 20283 blancher.)[d] After cooking in steam at 212° F. (100° C.) for 16 to 22 minutes, depending on the solids content of the potato (lower-solids content requires longer cooking) the slices were riced through 1/4-inch holes in a Chisholm Ryder Extractor, Model F.[d] Antioxidant, emulsifier, and sulfite solutions, when used, were incorporated into the mash in a Hobart Model L-800 mixer.[d] The mash was fed to the drum drier by applicator rolls as shown in Figure 3, and the product was removed by a "doctor" knife on the opposite side of the drum (Figure 4) in the form of a thin sheet the full width of the drum. The drier used was a small replica of a commercial single-drum drier, with a drying drum 2 feet in diameter and 3 feet long, manufactured by the Overton Machine Co.,[d] Dowagiac, Michigan. The sheet was broken into pieces of size convenient for packaging by passing

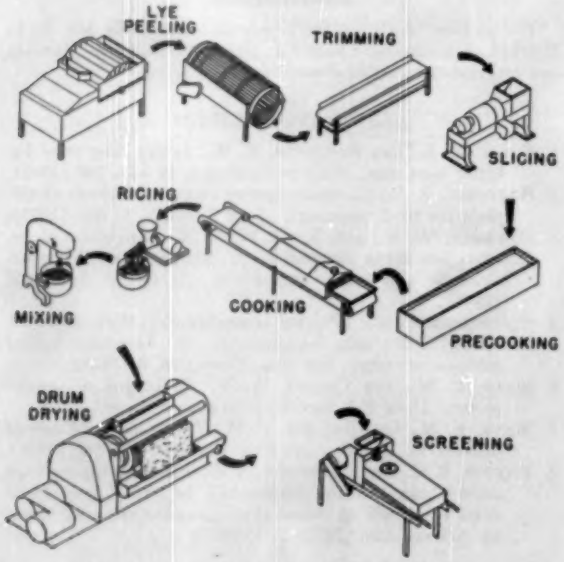

Figure 1. Flow sheet of pilot plant process.

Figure 2. Precooking potato slices.

[a] Presented at the Sixteenth Annual Meeting of the Institute of Food Technologists, St. Louis, Missouri, June 12, 1956.

[b] Present address: Rogers Bros. Seed Co., Idaho Falls, Idaho.

[c] A laboratory of the Eastern Utilization Research and Development Division, Agricultural Research Service, U. S. Department of Agriculture.

[d] Mention of trade name or company is this paper does not imply recommendation or endorsement by the U. S. D. A. over others not mentioned.

it between two rolls running in contact, one covered with 2-mesh hardware cloth and the other with rubber soft enough to permit compression of about ⅛-inch.

Procedure for obtaining drum-drier data. The speed of the drier drum was set by adjusting a variable-speed drive mechanism, and the temperature of the drum was brought to the test level by slowly increasing the steam pressure within the drum over a 15-minute period. Test conditions having been established, mash was fed to the drier until equilibrium was reached, then elapsed time was recorded for the feeding of 100-pound batches of mash. Flake production rates were taken for measured time intervals at equilibrium conditions. Solids content of the mash and of the flake was determined by analysis of composite samples taken over the period of the test, using a Brabender Moisture Tester, Type FRA.[4] Efficiency of the drier was determined by weighing the steam condensate from the drum and relating it to the water evaporated from the mash.

RESULTS AND DISCUSSION

Method of Application of Feed

Compared with double-drum. The method of application of mash to a single-drum flour-type drier is unique and offers some advantages not obtainable with double-drum driers. Mashed potato is fed to a double drum by placing it on the hot drum surfaces at, and immediately above the point where the drums come together. As the drums rotate the sheet separates into two parts, each drum carrying a relatively porous, non-uniform layer. When high-solids content potatoes are used, the sheet from a double-drum is "lacy", and dilution of the mash to about 20% solids is required to produce a sheet of satisfactory density.

On the single-drum drier, a number of "spreader" rolls, spaced around the periphery of the heated drying drum, as shown in Figure 3, are used to apply the mash. Their peripheral speed is the same as that of the drying drum. They are not heated. In preliminary tests, the clearance (from ⅛ to ½ inch) between these rolls and the drum did not appear to be critical as regards the amount of feed picked up by the drum. In the tests discussed here, the clearance was ⅛ to ¼ inch. To feed the drier, mash is placed in a trough above the drum, ahead of the first spreader roll. This roll picks up a layer as thick as the clearance between it and the drum. Each succeeding spreader roll is fed either by applying fresh mash to it or by transferring mash from the preceding roll. A thin film of mash adheres to the drum as it passes under the first roll, and the succeeding rolls apply more mash to fill in the interstices left by the preceding roll.

Effect on sheet density. The successive applications of mash to an already partially dried sheet on the single-drum drier produce a denser and slightly thicker sheet. It is also more uniform in cross-section than a sheet from the double-drum drier, as shown in Figure 5. The density of the single-drum sheet, expressed as pounds of solids per 100 square feet of sheet, increases as the number of spreader rolls fed is increased. Figure 6 shows sheet density versus number of spreader rolls used, with a drum speed of 1.88 r.p.m. and mash of 18.5% solids content. The great improvement in density obtainable from the single-drum drier with 4 spreader rolls over that from a double-drum unit fed as described earlier is apparent from the location of the double-drum point on Figure 6.

Solids Content of Feed

Producers of potato flakes will process potatoes of different solids content, depending on potato variety, growing area, and growing conditions. It is, therefore, important to show how the solids content of the feed affects the amount of mash picked up on the drier drum, since the pickup at a given drum speed controls the evaporative load on the drier and the rate of production, density, and moisture content of the product. In all experiments, 4 spreader rolls were used to feed the drier.

Effect on mash pickup by the drum. If the drum picked up the same weight of feed regardless of solids content, the evaporative load on the drier would decrease as the solids content increased. Experiments

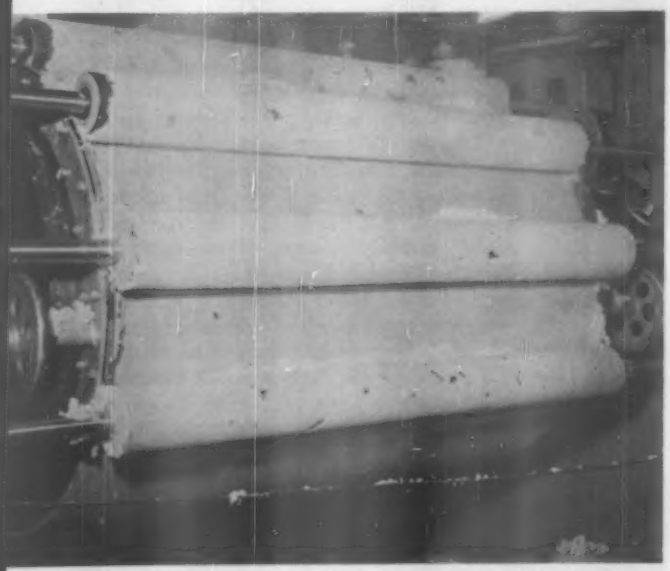

Figure 3. Application of mash to single-drum drier.

Figure 4. Product side of drier. Removing and breaking sheet.

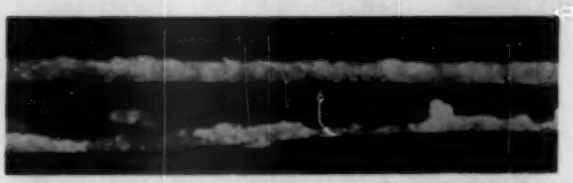

Figure 5. Photomicrographs of cross-section of sheets from single and double drum driers.
Top: Single drum; bottom: Double drum.

show, however, that it picks up more mash per unit area as the solids content increases, so much more that the amount of water picked up, as well as the amount of solids, is greater with high-solids potatoes. In Figure 7, pickup on the drum (pounds per hour per square foot of drum surface) is plotted against drum speed. Curves are shown for mash of 18.5, 20, and 21.5% solids content, and indicate the increase in pick-up of mash (and water and solids contained in it) at any given drum speed, as solids content increases.

Effect on production rate. As would be predicted from the solids pickup rate shown in Figure 7, production rates increase with increasing drum speed and with increasing solids content of the feed. This is shown in Figure 8. From Figures 7 and 8 alone, it would appear that the drum should be run at high speed to take advantage of the more rapid pickup of mash, greater production, and higher evaporative rate. The physical form of the product and its moisture content, however, must be considered.

Effect on sheet density. An important attribute of the drum-drier product is density, because this affects packaging costs. Since sheet thickness is nearly constant, density can be expressed as pounds of solids per 100 square feet of sheet produced. In Figure 9, sheet density is plotted against drum speed. Curves are given for mash of 18.5, 20, and 21.5% solids content. For each solids content, the sheet density increases as the speed of the drum is reduced. The increase is most rapid at speeds of 2 r.p.m. and lower. At any given drum speed, the density increases with the solids content. Sheet density will, if flake size is constant, control package size and influence packaging cost. Since packaging costs are comparatively high, a gain in production rate at high drum speed (Figure 8) may be offset by increased packaging cost through low density (Figure 9).

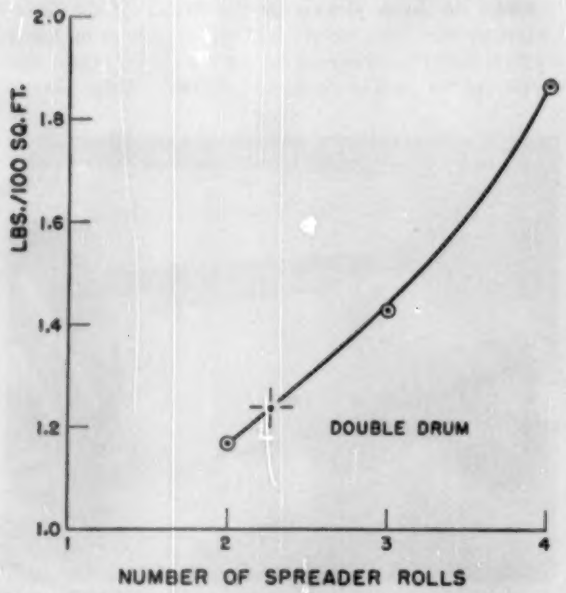

Figure 6. Effect of number of spreader rolls on sheet density.

Effect on moisture content of product. Figure 10 shows the relation between moisture content of the product and drum speed for mash of 18.5, 20, and

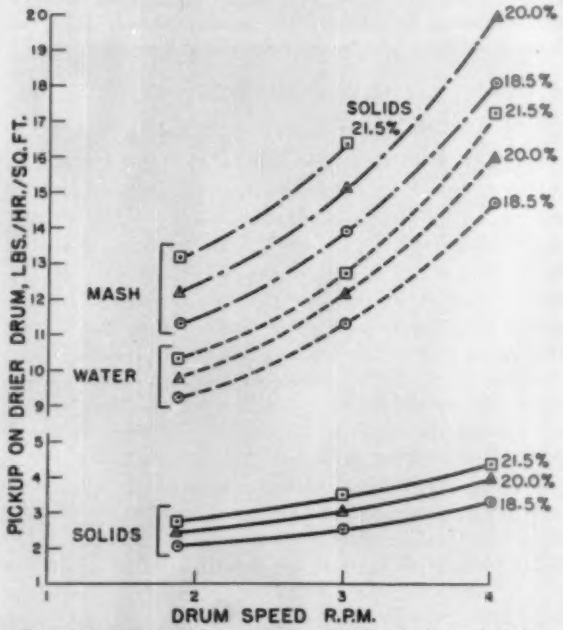

Figure 7. Effect of drum speed and solids content of feed on pickup by drum.

21.5% solids content. These data show that at a given drum speed the moisture content of the product increases as the solids content of the feed increases. It is indicated that for the range of feed solids content investigated, minimum moisture levels in the product are obtained at about 2 r.p.m. As drum speed is increased above 2 r.p.m., product moisture content increases because of the decreasing drying time. As drum speed is reduced below about 2 r.p.m., product moisture content increases again, probably because of the rapidly increasing resistance to diffusion due to increasing sheet density. The range of drum speed which will produce a flake of 5% moisture content or less, becomes narrower as the feed solids content increases. The range is about 1.8 to 2.3 r.p.m. for the highest solids content feed tested. The moistures shown in Figure 10 were obtained when the drier drum was heated with steam at 70 to 80 p.s.i.g. With the lower-solids content potatoes at higher drum speeds, steam pressure can be raised to 100 p.s.i.g. to obtain a lower moisture content in the product. With high-solids content potatoes, particularly at low drum speeds, increasing the steam pressure does not reduce moisture content. Under these conditions

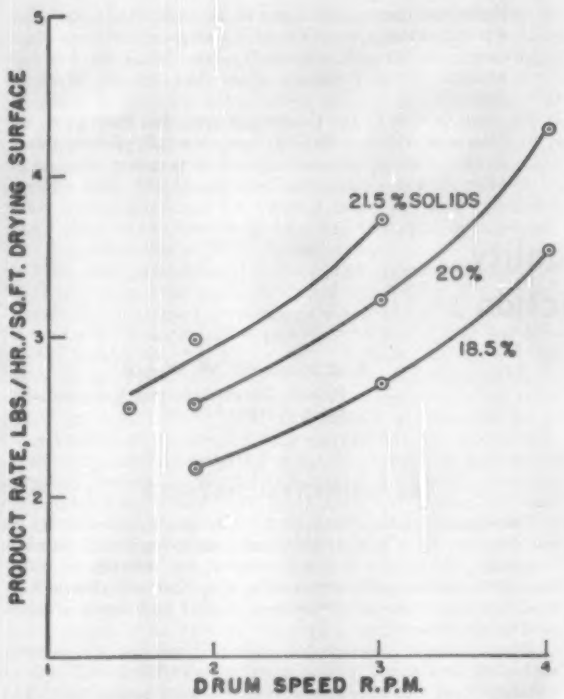

Figure 8. Effect of drum speed and solids content of feed on production rate.

a sheet of high density is produced, through which moisture diffuses slowly. The surface of the sheet in contact with the drum becomes over dried, while the average moisture content is still high, and the heavy sheet falls away from the drum before reaching the doctor knife.

One of the unusual features of the potato flake process is that a product of low moisture content can be obtained in a single drying step of 30 seconds or less. At low moisture content, nonenzymatic browning is greatly retarded, and the development of oxidative off-flavors can be retarded in potato flakes by the incorporation of an antioxidant in the mash before drying. It has been shown to be practical to produce flakes of 4 to 5% moisture content without flavor damage. In view of the advantages afforded by low moisture content, an upper limit of 5% moisture has been set for the production of samples made in the pilot plant for evaluation. Since this moisture content can be obtained at operating conditions which result in reasonable cost *(3)*, it is recommended that 5% moisture be set as a maximum in commercial production.

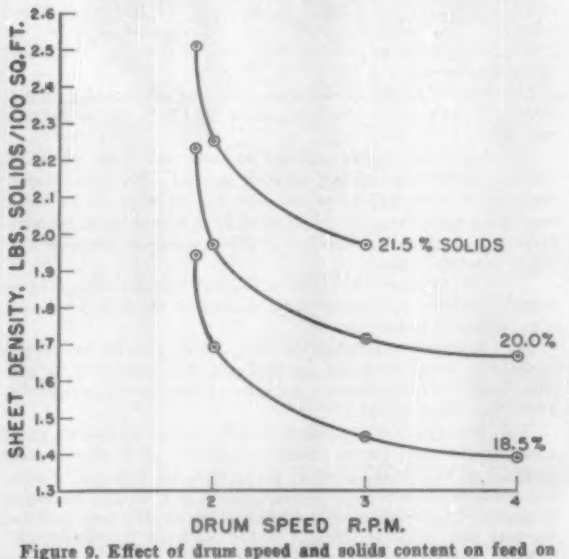

Figure 9. Effect of drum speed and solids content on feed on sheet density.

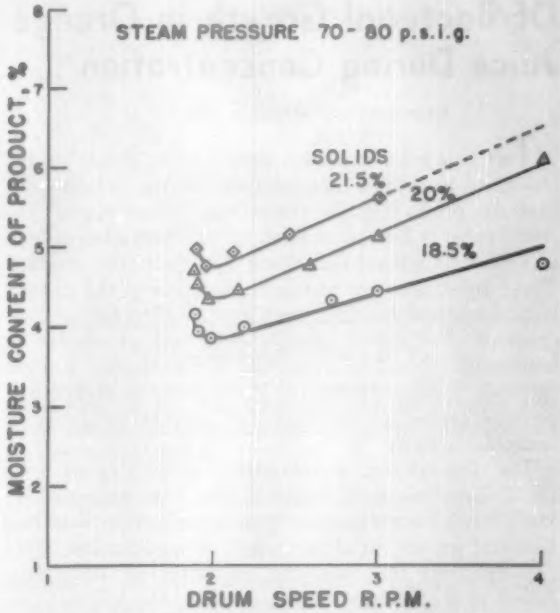

Figure 10. Effect of drum speed and solids content of feed on moisture content of product.

SUMMARY

This study was made to determine the effects of operating variables and of feed solids content on the production rate and physical characteristics of potato flakes made on a single-drum drier. The results show that in dehydrating mash of solids content in the range of 18.5 to 21.5%, the practical maximum sheet density is obtained at a drum speed just under 2 r.p.m. Minimum moisture in the product is obtained also at a drum speed of about 2 r.p.m., and the range of drum speed which will produce a flake of 5% moisture content or less becomes narrower as the feed solids content increases. With the highest solids content feed tested, this speed range is about 1.8 to 2.3 r.p.m. It is doubtful that the same absolute values will apply to a commercial drier of 4 to 4½ feet diameter. It is probable, however, that the same basic principles will apply.

LITERATURE CITED

1. Cording, James, Jr., Willard, Miles J., Jr., Eskew, Roderick K., and Edwards, Paul W. Potato flakes. A new form of dehydrated mashed potatoes. I. Pilot-plant process using double drum drier. U. S. Dept. Agr., Agr. Research Service *Circ. ARS-73-2;* 5 pp. (1954).

2. Cording, J., Jr., Willard, M. J., Eskew, R. K., Edwards, P. W., and Sullivan, J. F. Potato flakes. A new form of dehydrated mashed potatoes. II. Some factors influencing texture. U. S. Dept. Agr., Agr. Research Service *Circ. ARS-73-9;* 8 pp. (1955).
3. Eskew, Roderick K., Redfield, Clifford S., Cording, James, Jr., Willard, Miles J., Jr., Claffey, Joseph B., Edwards, Paul W., and Sullivan, John F. Potato flakes. A new form of dehydrated mashed potatoes. III. Estimated commercial cost. U. S. Dept. Agr., Agr. Research Service *Circ. ARS-73-12;* 15 pp. (1956).
4. Gemmill, Arthur V. Mashed potato flakes by low-cost process. (Staff Articles). *Food Eng.,* **28** (6) 82-84, 87 (1956).
5. Willard, Miles J., Jr., Cording, James, Jr., Eskew, R. K., Edwards, P. W., and Sullivan, John F. Potato flakes. A new form of dehydrated mashed potatoes. Review of pilot plant process. *Am. Potato J.,* **33** (1) 28-31 (1956).

The Diacetyl Test as an Aid for Quality Control of Citrus Products. I. Detection Of Bacterial Growth in Orange Juice During Concentration[a, b]

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(Manuscript received June 25, 1956)

The diacetyl test was developed to detect microbiological growth in orange juice during orange concentrate production in commercial evaporators. Diacetyl value is dependent upon the concentration of both acetylmethylcarbinol and diacetyl in the citrus product. These substances are metabolic products of the growth of acid-tolerant bacteria, such as *Lactobacillus* or *Leuconostoc.* Off-flavor, usually described as similar to buttermilk, occurs in a product if the diacetyl content becomes sufficiently large. Presence of acetylmethylcarbinol causes no off-flavor, but may be indicative of microbial activity.

The diacetyl test, a colorimetric method based upon the Voges-Proskauer reaction, was first suggested by Hill, Wenzel and Barreto *(5)* as a method for detecting bacterial growth in citrus juices or concentrate. Byer *(3)* modified this test and improved its sensitivity. Beisel *et al. (2)* used it to investigate the Voges-Proskauer reactants in California Valencia orange juice. Hays and Riester *(4)* and Murdock, Troy and Folinazzo *(6)* discussed the problem of the development in orange concentrates of off-flavors of bacterial origin.

Purpose of this report is to present additional data to demonstrate how the diacetyl test may be used to detect bacterial growth in orange juice during commercial concentration before off-flavor of the buttermilk-type has resulted. Spoilage and loss of the juice, which would occur if bacterial growth was allowed to continue, may thus be prevented by the application of the diacetyl test.

Results of the flavor evaluation of 435 commercial samples of frozen orange concentrate, collected during the 1953-54 and 1954-55 seasons, are reported to indicate that by the use of both good sanitary practices and quality control methods, including the diacetyl test and microscopic examinations, processors have been able to prevent the occurrence of buttermilk-type off-flavors in frozen orange concentrates. Diacetyl values for the 435 commercial concentrate samples are also reported.

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[b] Presented at the Sixteenth Annual Meeting of the Institute of Food Technologists, St. Louis, Mo., June 13, 1956.

EXPERIMENTAL METHODS

The diacetyl test. The basis for this test is that diacetyl, in the presence of alkali, creatine and alpha-naphthol, forms a compound that results in a red solution, the intensity of which may be measured colorimetrically; also that acetylmethylcarbinol in the presence of atmospheric oxygen and strong alkali is oxidized to diacetyl.

Diacetyl value, as reported in this paper, is the diacetyl equivalent of diacetyl and/or acetylmethylcarbinol in 25 ml. of distillate from 300 ml. of reconstituted orange concentrate. The diacetyl value was determined by using the following reagents, equipment, and procedure.

Reagents. (a) Alpha-naphthol solution. Dissolve 5 g. of alpha-naphthol (Eastman No. 170) in 100 ml. of 95% ethyl alcohol.

(b) Concentrated alkali solution containing creatine. Dissolve 40 g. of KOH in sufficient distilled water to make 100 ml. of solution and then add 0.3 g. of creatine (Eastman No. 951).

The reagents should be prepared daily or may be kept in brown bottles for 2 weeks if refrigerated.

Equipment. The colorimeter used was a Fisher Electrophotometer. A 525 mμ filter and 3 ml. round glass absorption cells were used.

Procedure. (a) Reconstitute sample of citrus concentrate to be tested to 12° Brix ± 0.2°.

(b) Distill 25 ml. from 300 ml. of reconstituted juice using an efficient condenser. Collect the distillate in a 25 ml. graduated cylinder. The distillate should flow down the sides of the graduated cylinder to prevent dispersion of peel oil, which will cause cloudiness.

(c) Pipette 10 ml. of distillate from the graduated cylinder, without disturbing any floating peel oil, into a 25 mm. x 200 mm. test tube.

(d) Add 5 ml. alpha-naphthol solution and 2 ml. of KOH solution containing creatine, stopper the test tube, shake vigorously for 15 sec., and allow to stand for 10 min. Shake again vigorously for 15 sec. In the same manner and at the same time, prepare a reagent blank using distilled water in place of distillate from the juice.

(e) Fill colorimeter tubes with test sample and reagent blank. Null the colorimeter with a reagent blank and measure color intensity in test sample.

(f) Determine concentration in p.p.m. of diacetyl by using a calibration curve obtained by applying this procedure to distilled water to which known amounts of diacetyl (Eastman No. 1591) have been added.

The diacetyl test should be made using analytical grade reagents of known purity. Isopropyl alcohol, 99%, may be used in place of 95% ethyl alcohol; because of its accessibility without regulations, it is used in most plants as a solvent for alpha-naphthol. The color produced when ethyl alcohol was used had its peak absorption at 545 mμ; at 535 mμ when isophropyl alcohol was used. The reaction time allowed between the addition of

the reagents and the time at which the colorimeter readings are made must be carefully controlled, because the color developed by the reaction changes and decreases steadily after reaching a maximum. The rate of change in color, after the addition of the reagents, is different when ethyl alcohol is used from that occurring with isopropyl alcohol.

Microbiological methods. Direct microscopic counts were made from slides prepared as described by Hill, Wenzel and Barreto *(5)*. The number of microorganisms in each of 25 fields was counted and the average count per field calculated. Total plate counts were made by using orange serum agar, pH 5.6, with incubation at 30° C. for 48 hr.

Pilot plant procedures. A 2-stage, high-vacuum, low-temperature pilot-plant evaporator, described by Atkins, Wenzel and Moore *(1)*, was used for the processing of 20° Brix orange concentrate for an extended period of 13 hr. so that bacterial growth would occur in the product. Sufficient pasteurized 20° Brix orange concentrate was divided into 2 batches. One of these was put into the first stage of the evaporator. The other batch was inoculated with a very actively growing culture of *Lactobacillus plantarum* and then pumped into the second stage of the evaporator. No mixing of the two batches of concentrate occurred initially or during subsequent processing, since the connecting pipe between the two stages was closed by means of a valve. Mixing of vapor from the separation chambers was possible during processing, but apparently did not occur to any significant extent.

The two batches of product were continuously processed under vacuum for 13 hr. during which time the concentration of the concentrate in each of the stages was maintained at 20° Brix by the addition of pasteurized deionized water. Temperature of 78° to 82° F. was maintained in the concentrate in the pan of the evaporator. At hourly intervals, samples of concentrate were withdrawn from both the first and second stages of the evaporator for examination using the diacetyl test and microbiological methods. Results are shown in Table 1 and Figure 1.

Commercial plant procedures. Data were collected during the 1953-54 season at a commercial concentrate plant. Diacetyl tests were made on orange juice going to the evaporator, products from the four stages of the evaporator, the pulpy cutback juice, and on the finished canned concentrate. It was thus determined that bacterial growth in juice during concentration could be detected most readily by testing juice from the second stage. Therefore, most of the data were obtained by determining diacetyl values and plate counts on samples of product withdrawn at regular intervals from the second stage of the evaporator. Some of the data are presented in Table 2 and Figure 2.

TABLE 1

Diacetyl values and microbiological counts in pasteurized 20° Brix orange concentrate, pH 4.0, after inoculation with Lactobacillus plantarum and processing in evaporator [2]

Processing time	Product inoculated—second stage of evaporator[2]			Product not inoculated—first stage of evaporator[2]	
	Diacetyl value	Direct microscopic count	Plate count	Diacetyl value	Plate count
hr.	p.p.m.	Average of 25 fields	Orange serum agar, pH 5.6	p.p.m.	Orange serum agar, pH 5.6
Initial	3.1	0.4	480,000	2.7	930
1	1.1	0.4	.....	0.2	.....
2	1.1	0.4	840,000	0.1	1,950
3	1.1	0.5	.....	0.2	.....
4	1.2	0.6	1,060,000	0.2	3,000
5	1.3	0.8	.....	0.1	.....
6	1.6	0.9	1,115,000	0.2	7,500
7	1.7	1.4	.....	0.1	.....
8	2.3	2.4	2,645,000	0.2	6,700
9	3.0	3.1	.....	0.2	.....
10	3.8	3.6	4,850,000	0.2	39,000
11	4.4	5.0	.....	0.1	.....
12	5.7	5.3	7,300,000	0.1	57,600
13	7.3	5.9	6,400,000	0.3	106,600

[1] The concentration of the product in both stages of the evaporator was held constant at 20° Brix during processing by the addition of pasteurized deionized water. The temperature of the juice in the pan of the evaporator was maintained at 78° to 82° F.

[2] There was no circulation of product between the first and second stages of the evaporator.

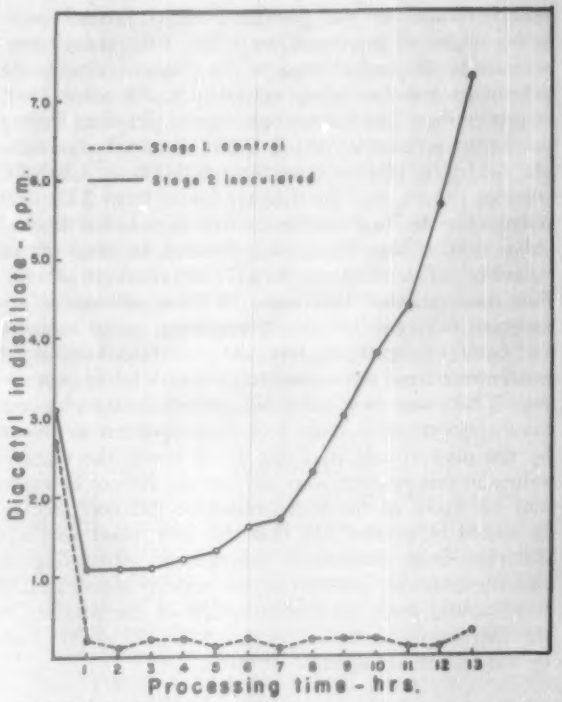

Figure 1. Diacetyl values in pasteurized 20° Brix orange concentrate, pH 4.0, after inoculation with Lactobacillus plantarum and processing in pilot plant evaporator. Addition data are reported in Table 1.

Examination of samples of commercial frozen orange concentrate. During the 1953-54 and 1954-55 seasons, samples of commercial frozen orange concentrate were collected twice each month from 24 Florida plants. The diacetyl value in 435 samples was determined; a frequency graph of these values is shown in Figure 3. The flavor of these commercial products was also evaluated by a taste panel which averaged 7 persons, varying from a minimum of 5 to a maximum of 9. The reconstituted orange concentrates were tasted at room temperature and flavor defects noted when juices were graded as poor in quality.

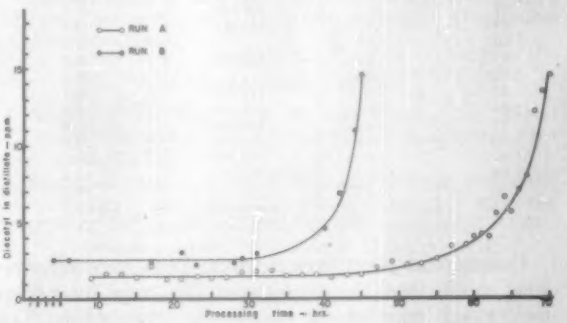

Figure 2. Diacetyl values in orange concentrate in second stage of commercial evaporator during continuous operation.

RESULTS AND DISCUSSION

Pilot plant investigation. Data reported in Table 1 and Figure 1 for diacetyl values, microscopic and plate

counts show that the growth of *Lactobacillus plantarum* increased gradually in the 20° Brix orange concentrate in the second stage of the evaporator, with the rate of growth becoming markedly faster after 7 hr. of processing. The microscopic counts increased during the 13 hr. processing period from 0.4 to 5.9 organisms per field; the plate counts from 480,000 to 7,300,000 colonies per ml. and the diacetyl values from 3.1 to 7.3 p.p.m. The decrease during the first hour in the diacetyl value from 3.1 to 1.1 p.p.m. resulted because of the volatility of both diacetyl and acetylmethylcarbinol; this also indicated that some of these substances are removed from products being processed under vacuum. Off-flavor of significant intensity was detectable in the concentrate from the second stage after 9 hr. of processing. There was some microbial growth in the uninoculated concentrate in stage 1 of the evaporator as shown by the plate counts in Table 1; however, the diacetyl values in this product were very small, did not increase, and off-flavor of the buttermilk-type did not develop. It should be pointed out that this pilot plant run was different from continuous commercial processing in that there was no addition of raw juice or withdrawal of concentrate, since the concentration of the product in the two stages of the evaporator was held at 20° Brix by the continuous addition of water.

TABLE 2

Diacetyl values and microbiological counts in orange concentrate in second stage of commercial evaporator during continuous operation

Processing time	Diacetyl value	Plate count	Concentration of juice from evaporator
hr.	p.p.m.	Orange serum agar, pH 5.6	° Brix
9	1.3	.....	22.0
19	1.3	2,000	18.5
29	1.7	20,500	21.0
39	1.6	13,500	19.5
49	2.4	30,500	20.0
51	2.2	61,000	21.0
53	2.3	63,500	20.5
55	2.6	75,500	22.0
57	3.4	200,000	21.5
59	3.5	155,000	20.5
60	4.0	.....	18.0
61	4.2	560,000	18.8
62	4.0	.....	21.5
63	5.6	585,000	16.5
64	6.6	560,000	17.5
65	5.6	660,000	21.8
66	7.1	1,360,000	20.0
67	8.0	985,000	20.0
68	12.2	2,300,000	14.5
69	13.5	3,350,000	19.5
69.5	14.6	2,700,000	20.5

Commercial plant investigation. Data were accumulated chiefly from the examination of orange juice from the second stage of the commercial evaporator. The juice concentration, determined with a hand refractometer, in this stage of the evaporator was usually in the range of 18° to 22° Brix as is shown in Table 2. Using the diacetyl test, preliminary data were obtained to find out existing conditions in juice being concentrated in this plant. Before the evaporator was to be shut down for a general cleaning of the entire plant, a diacetyl value of 8.8 p.p.m. was found in juice from the second stage; this increased very rapidly to 19.7 p.p.m. at which time processing was discontinued. The evaporator and plant were then thoroughly cleaned. During the following day, the diacetyl value ranged between 1.2 and 2.2 p.p.m. and during the second day of operation the range was 1.8 to 2.8 p.p.m. After 64 hr. of processing, a diacetyl value of 12.8 p.p.m. was obtained and followed

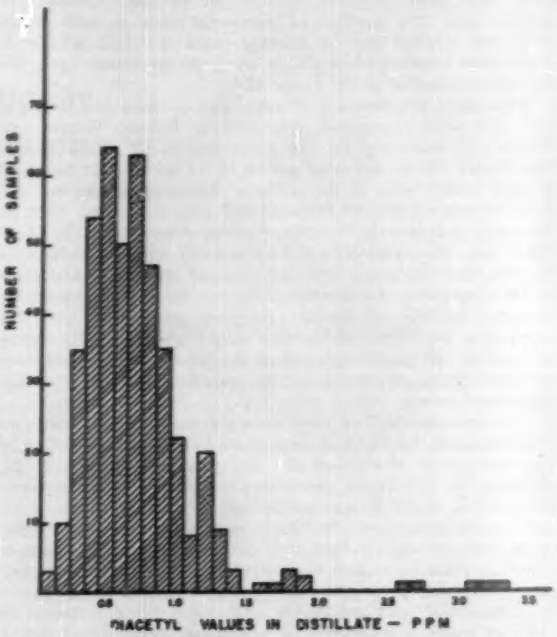

Figure 3. Frequency graph of diacetyl values in 435 commercial samples of frozen concentrated orange juices collected from 24 Florida plants during the 1953-54 and 1954-55 seasons.

by a very rapid increase to 28.7 p.p.m. At this time evaporation of juice was again stopped. It should be pointed out that during continuous operation frequent cleaning of extractors, finishers and other equipment was done, but in such a manner that the evaporators did not have to be closed down.

Having the previously mentioned data, it was decided to obtain diacetyl values and plate counts from juice in the evaporator every 1 or 2 hr., starting shortly after the plant was cleaned thoroughly and continuing until the evaporator was again stopped. The diacetyl values obtained during a period of continuous operation of almost 70 hr. are shown graphically in Figure 2, Run A; some of the plate counts, together with the corresponding diacetyl values, are reported in Table 2. There was a gradual rise in the diacetyl values after 45 hr. of operation, which increased above 5 p.p.m in 63 hr., and then the diacetyl content in the distillate increased rapidly to 14.6 p.p.m. during the next 6.5 hr. Good correlation was found between the diacetyl values and the plate counts.

Diacetyl values found in juice being evaporated during another run (Run B) are also shown in Figure 2. In this instance, the 5 p.p.m. level was reached after the relatively short time of only 38 hr. of operation; the rapid increase in the diacetyl and/or acetylmethylcarbinol in the product after the 5 p.p.m. level was reached was again evident.

On the basis of the information obtained at this plant, it was recommended that concentration of juice should be discontinued when a diacetyl value of 5 p.p.m. was reached in juice in the second stage of the evaporator. All data indicated that bacterial growth would increase very rapidly, if processing was continued after the 5 p.p.m. level was reached, and that consequently off-flavor would eventually become apparent in the finished 42° Brix orange concentrate. Buttermilk-type off-flavor was definitely detectable in concentrate from the last stage of the evaporator after 69 hr. of operation and this sample had a diacetyl value of 4.9 p.p.m. Comparison of this value with 12.2 p.p.m. in juice from the second stage after 68 hr. indicated that a large amount of the diacetyl and/or acetylmethylcarbinol produced by bacterial growth in juice in the low-Brix stages was removed during the concentration of the product in the high-Brix stages of this commercial evaporator. Hill, Wenzel and Barreto *(5)* previously reported a decrease of 70% in diacetyl value when spoiled 20° Brix orange juice was concentrated from 20° to 60° Brix in a pilot plant evaporator.

It should be mentioned that the maximum limit for the diacetyl value to be used as an indication for imminent bacterial growth and subsequent spoilage of product will not be the same for all concentrate plants, because it may be affected by differences in evaporators and plant procedures. Therefore, the maximum diacetyl value permissible in evaporator juice has to be determined by quality control personnel in each plant. At the present time, both the diacetyl and direct microscopic count methods are being used in control laboratories in Florida plants for the detection of microbial growth in citrus juices during concentration.

Finally, attention should be called to the fact that thermal stabilization of orange juice for concentration was being used in the commercial plant where data in this report were obtained. Nevertheless, bacterial growth occurred in juice in the evaporator. Therefore, thermal treatment of juice prior to concentration does not eliminate completely the possibility of bacterial spoilage, even though the stabilization procedures used, which protect the product against enzymic changes, do reduce the bacterial content of the evaporator-feed juice to a very low level.

Diacetyl values in commercial frozen orange concentrates. Although the primary purpose of the diacetyl test is to aid in the detection of microbiological activity in citrus juices in evaporators, some interest has developed and questions have been asked about the diacetyl values found in citrus juices or concentrates. Therefore, diacetyl values were determined and are reported for some commercial samples of frozen orange concentrates. Because of various factors involved, the relationship of diacetyl values to the quality of citrus juices or concentrates remains to be determined after sufficient data on this problem have been obtained.

A frequency graph, Figure 3, shows results obtained when 435 samples of commercial frozen concentrates were reconstituted and diacetyl values determined. These samples were collected twice monthly from 24 Florida plants during the 1953-54 and 1954-55 seasons. The diacetyl values found in the reconstituted juices ranged from 0.1 to 3.3 p.p.m. and 88% of the juices had diacetyl values of 1.0 p.p.m. or less. Flavor evaluation of the 435 samples by the taste panel resulted in only 5 or 1.1% being rated as poor in quality because of buttermilk-type off-flavor. The diacetyl values found in these 5 orange concentrates were 1.2, 2.6, 3.1, 3.2 and 3.3 p.p.m.

Results from the flavor evaluation of the commercial concentrates indicate that, even though bacterial spoilage can occur in juice during concentration in commercial evaporators, processors are preventing such spoilage by using good sanitary plant practices together with quality control tests, such as the diacetyl test and microscopic counts, so that today the consumer seldom finds buttermilk-type off-flavor in commercial frozen orange concentrates.

SUMMARY

Orange concentrate, pH 4.0 and 20° Brix, was inoculated with *Lactobacillus plantarum* and recirculated in a pilot plant evaporator until spoilage of the product occurred. Diacetyl values, direct microscopic counts, and plate counts, determined on samples of concentrate withdrawn from the evaporator every hour, are reported and were indicative of bacterial growth.

Data obtained during commercial plant operation are presented and illustrate the use of the diacetyl test for the detection of bacterial growth in orange juice in commercial evaporators before spoilage occurs, thereby preventing loss of product.

Diacetyl values were determined for 435 samples of commercial frozen orange concentrate, which were collected during two years from 24 Florida plants.

Acknowledgments

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The assistance of Miss Betty Jo Andrews and Mrs. Maxine Melvin in performing many of the tests during this investigation is also acknowledged.

LITERATURE CITED

1. Atkins, C. D., Wenzel, F. W., and Moore, E. L. Report new technical strides in design of FCC evaporator. *Food Inds.*, **22**, 1353 (1950).
2. Beisel, C. Gordon, Dean, R. Willard, Kitchel, Robert L., Rowell, Kenneth M., Nagel, Charles W., and Vaughn, Reese H. Sources and detection of Voges-Proskauer reactants in California Valencia orange juice. *Food Research*, **19**, 633 (1954).
3. Byer, Ellis M. Visual detection of either diacetyl or acetylmethyl-carbinol in frozen concentrated orange juice. *Food Technol.*, **8**, 173 (1954).
4. Hays, G. L., and Riester, D. W. The control of "off-odor" spoilage in frozen concentrated orange juice. *Food Technol.*, **6**, 386 (1952).
5. Hill, E. C., Wenzel, F. W., and Barreto, A. Colorimetric method for detection of microbiological spoilage in citrus juices. *Food Technol.*, **8**, 168 (1954).
6. Murdock, D. I., Troy, V. S., and Folinazzo, J. F. Development of off-flavor in 20° Brix orange concentrate inoculated with certain strains of *Lactobacilli* and *Leuconostoc*. *Food Technol.*, **6**, 127 (1952).

The Effect of pH on the Growth of Salmonella and Functional Properties Of Liquid Egg White[a]

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ALTHOUGH EGG WHITE contains antibacterial substances such as lysozyme, avidin, conalbumin, and antitrypsin, bacteria can multiply in the presence of this medium *(2, 5, 7, 13)*. The growth of organisms, and in particular of members of the genus *Salmonella*, is an important consideration when reducing sugars are removed by fermentation or enzyme treatment prior to drying egg white. Removal of glucose is necessary *(3, 12, 14)* in order to produce a stable dried product. Fermentation is generally accomplished by employing organisms such as *Saccharomyces*, *Streptococcus* or *Aerobacter*. Under the conditions used in fermentation, contaminants of the genus *Salmonella* may reproduce and become a health hazard in the dried product. As a consequence it is desirable to develop methods to inhibit growth of these organisms. One possible method that might be used to limit reproduction of *Salmonella* in liquid albumen is to alter the pH of the medium. Addition of acids or bases to the liquid melange is already employed in producing dried albumen; hence, alteration of pH would not be difficult.

Production of an acid environment has been used for centuries to aid in preserving various food products. Egg white is unique among foods in that, in its natural state, an alkaline condition prevails. A pH value of 7.5 was found to exist *(6, 9)* in fresh egg white whereas, after storage, this value rose to pH 9.5. An alkaline condition is not necessarily detrimental to the functional properties of egg white. Adjustment of the pH of fermented albumen to pH 9 with NH_4OH just prior to drying was found *(2)* to improve the whipping quality of the reconstituted product while the use of NaOH decreased its whipping power. On the other hand it was shown that mucin precipitated *(8)* when egg white was adjusted to pH 6.0-6.4 and that the functional properties of the albumen were not impaired by fermentation until the pH reached 6.0-6.5. Sharp and Whitaker *(10)* determined the germicidal action of egg white in the range from pH 5.3 to pH 10.6. According to their report, egg white at pH 9.5 inhibited the growth of *Bacillus subtilis*, *B. cereus* var. *mycoides*, *B. megaterium*, *Escherichia coli*, *Pseudomonas fluorescens*, *Serratia marcescens*, and *Proteus vulgaris*. In egg white having pH values of 8.5 only the first two organisms were inhibited.

Dernby *(4)* studied the effects of pH on the growth of 40 species of bacteria and found that pathogenic organisms such as *B. typhosus (Salmonella typhosa)* were able to produce optimum growth within a restricted pH range. Limiting pH values for growth of *S. typhosa* were pH 6.2 to 7.6; for *B. paratyphi A (S. paratyphi)* pH 4.5 to 7.8 and for *B. paratyphi B (S. schottmuelleri)* pH 4.5 to 8.0.

The experiments reported here were conducted in order to determine the possibility of altering the pH of egg white so that growth of *Salmonella* would be inhibited. In addition, a limited number of experiments were undertaken to test the functional properties of cakes prepared from albumens of pH 6.0 to pH 10.0.

METHODS AND MATERIALS

Fresh eggs obtained from the Iowa State College Poultry Farm were broken and separated as reported previously *(1)*. The pH of the egg white was measured by means of a Beckman pH meter (model H) and was adjusted to the desired level by addition of either 5% hydrochloric acid or 5% ammonium hydroxide solution. The levels of pH striven for were pH 6.0, 7.0, 8.0, 9.0, and 10.0.

After adjustment of the pH, the liquid egg white was inoculated with *Salmonella oranienburg* (WURB 6266), *S. senftenberg* (WURB 775W) or *S. pullorum* (WURB 3083). Cultures of these organisms were prepared as described earlier *(1)*. The inoculated liquid egg white was then dispensed into sterile test tubes, incubated in a water bath at the temperature recommended for fermentation of the albumen (30° C.) and sampled at 0, 2, 4, 8, and 24 hours. The samples were diluted in sterile distilled water and the numbers of *Salmonella* were estimated by spreading 0.5 ml. of the appropriate dilution with a sterile glass rod onto a brilliant green agar surface in a Petri dish. After incubation for 24 hours at 37° C., colonies of *Salmonella* were counted with the aid of a Spencer colony counter.

For tests of the organoleptic quality of albumen after adjusting with acid or alkali to pH 6.0, 7.0, 8.0, 9.0 or 10.0, 250 ml. batches of egg white were poured onto aluminum trays (16 in. x 11½ in. x 1 in.) to a depth of about 1/16 inch. Trays were placed under a battery of infra-red heat lamps. Care was taken to keep the temperature of the albumen below 40° C. until a "heavy skin" formed on the surface. The lamps were then turned off and drying was completed with the aid of a fan moving air heated to about 27° C.

After drying, each lot of albumen was reconstituted by adding 200 ml. of water to the tray. After allowing the albumen to rehydrate for one hour, the contents were scraped into a clean pint fruit jar. An additional 20 ml. of water was added to the tray and any albumen remaining was allowed to soak a few minutes before it, too, was scraped into the jar. Immediately following reconstitution, pH and specific gravity determinations were made. For the latter, 60 g. of rehydrated egg white, 47 g. of sugar, 0.9 g. of cream of tartar, and 0.3 g. salt were blended as follows: Temperature of the egg white was adjusted to 21.1° C. by placing the mixer bowl in a water bath adjusted to that temperature. Albumen was whipped using a KitchenAid K4B mixer at speed 10. Salt and cream of tartar were added at the start. The 47 g. of sugar was added in three equal portions at 10, 15 and 20 seconds. Whipping was continued until 30 seconds mixing time had elapsed; then the specific gravity of the meringue was determined by carefully level-filling a tared ¼ cup (60 ml.) round-bottomed measuring cup. This same procedure also was used for the determination of specific gravity of the meringue at the end of a 60 second interval.

A procedure similar to that described for the 30-second gravity test was used in preparing meringue for angel cakes. No attempt was made to continue or stop whipping at the "soft

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[b] Present address: United States Department of Agriculture, Customs House, Chicago, Illinois.

peak stage" since it was desired to maintain uniform time of whipping. The flour-sugar mixture, consisting of 22 g. of cake flour and 15 g. of sugar sifted together 3 times, was folded into the meringue in three equal portions using 10 strokes of a wire whip after each addition. After determining the pH of the batter, 110 g. of the material was placed in rectangular pans having nearly perpendicular sides (5 in. x 3 in. x 2¾ in.), and the batter baked for 25 minutes at 176.7° C. Cakes were allowed to cool overnight in an inverted position; then the top of the cake was dusted with flour and the volume determined by the seed displacement method.

After removing the cakes from the pans they were judged for quality by a 10-point numerical judging system (1-10). Judges were given instructions to make evaluations using the following criteria:

Texture—coarse or fine grain, airiness (light) or compactness (heavy) of texture, uniformity of air cells, thin or thick cell walls and/or large or small cells, tender or tough texture.

Flavor—bland, acid, alkaline-"chalky", bitter, metallic, other off-flavors and aftertastes.

Moisture—mouth-feel, moist, dry, "fresh", "stale".

RESULTS AND DISCUSSION

Curves plotted from the data obtained by growing *S. pullorum* in egg white at pH 6.0 to pH 10.0 are depicted in Figure 1. Curves for *S. oranienburg* and *S. senftenberg* followed similar trends and, therefore, are not shown. As the pH of the liquid egg white was increased, the growth of *S. pullorum* decreased noticeably.

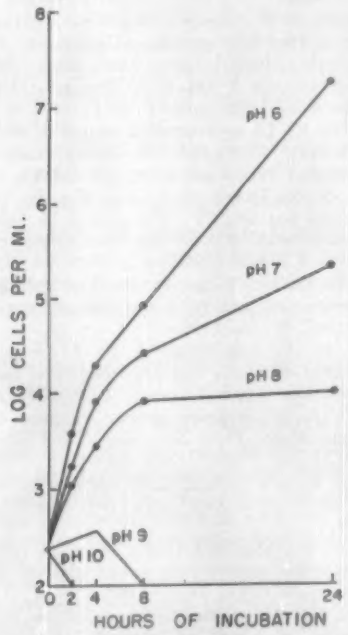

Figure 1. Growth of S. pullorum in egg white at pH 6 to 8.

This characteristic was also observed for *S. oranienburg* and for *S. senftenberg*. The number of *S. pullorum* growing for 24 hours was 60 times greater when the liquid egg white was adjusted to pH 6.0 rather than to pH 7.0; also, the number of cells of *S. pullorum* was 30 times greater when the albumen was adjusted to pH 7.0 rather than to pH 8.0.

Reductions in number of *S. pullorum*, *S. oranienburg*, and *S. senftenberg* occurred when these organisms were inoculated in the egg white adjusted to pH 9.0 or pH 10.0. Between the values of pH 8.0 and pH 9.0 there is a concentration of hydroxyl ions which can be tolerated by, but is not favorable to the growth of, *Salmonella*. This value apparently is closer to pH 9.0 than pH 8.0 since experiments conducted at pH 8.5 continue to reveal small increases in numbers of *S. pullorum* within 24 hours.

Effect of the pH of the egg white on growth of *Salmonella* is further indicated by the generation times listed in Table 1. Alteration of pH from 6.0 to 7.0 resulted in doubling the generation time of *S. pullorum*. Increase in generation time between pH 7.0 and pH 8.0 was less than that between pH 6.0 and pH 7.0. Less marked bacteriostatic action due to hydroxyl ions was noted for *S. oranienburg* or *S. senftenberg*. However, generation time for *S. oranienburg* at pH 8.0 was more than 1.5 times that at pH 6.0 Since no growth occurred at pH 9.0 or pH 10.0, calculation of generation times at these pH levels was not possible.

TABLE 1
Generation time (in minutes) of Salmonella in liquid egg white

Organism	pH of egg white		
	6.0	7.0	8.0
S. pullorum	72	140	150
S. oranienburg	46	65	72
S. senftenberg	46	51	53

It may be seen (Table 2a) that pH adjustment of the liquid albumen with ammonium hydroxide had only slight effect on the pH of the reconstituted albumen after pan drying. On the other hand, adjustment with hydrochloric acid resulted in lowering the pH of the pan-dried albumen and, when acidified to pH 6, led to increased specific gravity of the meringue. Angel cakes baked from albumens of pH 6-10 (Table 2b) showed pronounced differences. Cakes prepared from albumens adjusted to pH 6.0, 7.0 or 10.0 had much less desirable texture, flavor, and volume than did those to which less acid or alkali were added. However, the volume of cake in which albumen of pH 9.0 was used was greater than that of the unadjusted control. Since no flavoring was added to any of these cakes, it is not known if the slight "chalky" after-taste that was characterized by three of the judges would have been detectable in a cake con-

TABLE 2a
Effect of pH adjustment of liquid albumen on the pH and whipping properties of the reconstituted product

Albumen		Meringue		
pH adjusted with acid or alk. to:	pH after pan-dried and reconstituted	pH	Specific gravity	
			30 seconds	60 seconds
6	7.4	5.0	.214	.183
7	8.6	6.1	.196	.170
8	8.9	6.6	.194	.169
9	8.9	6.6	.190	.166
10	9.0	6.7	.202	.172
Unadjusted control (pH 8.5)	8.9	6.6	.193	.175

taining the usual amount of flavor. It is interesting that, although pH's of most commercial albumens are reduced to favor more rapid yeast or bacterial fermentation or enzyme treatment, cakes produced from albumen of low pH received poor acceptance in these trials.

Evidently, it is possible to restrict the growth of *Salmonella* in liquid albumen merely by adjusting the egg white to pH 9.0 or higher; however, with present methods it would be difficult to remove the glucose at these pH levels. If a method to remove glucose could be devised that would function efficently at a high pH, one could utilize this procedure to prevent growth of *Salmonella*. With present methods of removing glucose from liquid albumen, care should be exercised to maintain as high a pH as possible so that the process is efficient and at the same time retards reproduction of *Salmonella*. Another possibility is that, after removing the glucose, one might add ammonium hydroxide to the melange in order to minimize the load of organisms before drying.

TABLE 2b
Effect of pH adjustment of liquid albumen on the pH of the batter and on the texture, moistness, flavor, and volume of angel cakes

Albumen	Batter	Cake				
pH	pH	Texture		Moistness	Flavor	Volume
		Score	Characteristics	Score	Score Characteristics	ml./110 ml. batter
6	4.7	7.2	Very coarse grained Cell walls thick Cake tough	8.0	6.3 Acid Metallic flavor	554
7	5.2	7.5	Somewhat coarse grained	8.1	7.2 Sl. sour Sl. metallic	583 592
8	5.7	7.7	Fine grained Tender Thin cell walls	8.3	8.4 Good	
9	5.9	8.3	Fine grained Tender Thin cell walls	8.4	8.2 Slight "chalky" or alkaline after taste	623
10	6.1	7.5	Fine grained Compressed Cake tough	8.2	7.3 Alkaline after taste	545
Unadjusted control pH 8.5	5.9	8.4	Fine grained Tender Thin cell walls	8.6	8.5 Excellent	591

Score of 10 is maximum; average for 6 judges.

SUMMARY

Aliquots of liquid egg white, adjusted to pH 6.0, 7.0, 8.0, 9.0 or 10.0, were inoculated with *Salmonella pullorum*, *S. oranienburg*, or *S. senftenberg* and incubated at 30° C. After incubation for 0, 2, 4, 8, or 24 hours, albumen samples were analyzed for the numbers of *Salmonella* present.

Within the range pH 6.0 to pH 8.0 the numbers of viable *Salmonella* decreased as the pH of the liquid albumen increased and, for *S. pullorum*, the generation time was doubled. When egg white was adjusted to a pH of 9.0 or 10.0, there was a reduction in the number of organisms surviving. With present methods of glucose removal, the pH of albumen should be kept as high as possible in order to restrict the growth of any contaminating *Salmonella*.

Adjustment of the pH of liquid albumen with ammonium hydroxide caused very little change of pH in the dried product. However, addition of hydrochloric acid to the albumen not only resulted in increased acidity of the rehydrated albumen but also produced a heavier meringue. Cakes prepared from albumens of pH 6.0, 7.0 or 10.0 had less desirable texture, flavor, and volume than did those from albumens of pH 8.0, 8.5 or 9.0.

It is suggested that a method for removing glucose be devised that can function at high pH levels, or that after removing glucose, the pH can be adjusted to the alkaline range before drying.

Acknowledgment

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LITERATURE CITED

1. Banwart, G. J., and Ayres, J. C. The effect of high temperature storage on the content of *Salmonella* and on the functional properties of dried egg white. *Food Technol.*, 10, 68 (1956).
2. Bollenback, C. H. Removal of glucose from egg albumen by a controlled fermentation. (Unpublished Ph.D. thesis, Iowa State College Library, Ames, Iowa, 1949).
3. Carlin, A. F., and Ayres, J. C. Storage studies on yeast-fermented dried egg white. *Food Technol.*, 5, 172 (1951).
4. Dernby, G. K. La concentration optima in ions hydrogene favorisant le development de certains micro-organisms. *Annales de L'Inst. Pasteur*, 35, 277 (1921).
5. Gibbons, N. E., Moore, R. L., and Fulton, C. O. Dried whole egg powder, XV. The growth of *Salmonella* and other organisms in liquid and reconstituted egg. *Can. J. Research*, F 22, 169 (1944).
6. Healy, D. L., and Peter, A. M. The hydrogen ion concentrations and basicity of egg yolk and egg white. *Am. J. Physiol.*, 74, 363 (1925).
7. Hurley, N. A., and Ayres, J. C. A comparison of six enrichment media for isolating *Salmonella pullorum* from egg products. *Appl. Microbiol.*, 1, 302 (1953).
8. McNally, E. H. Relative amounts of mucin in thick and thin egg white. *Proc. Soc. Exptl. Biol. Med.*, 30, 1254 (1933).
9. Sharp, P. F., and Powell, C. K. Increase in the pH of the white and yolk of hens' eggs. *Ind. Eng. Chem.*, 23, 196 (1931).
10. Sharp, P. F., and Whitaker, R. The relation of the hydrogen-ion concentration of egg white to its germicidal action. *J. Bacteriol.*, 14, 17 (1927).
11. Slosberg, H. M. Some factors affecting the functional properties of liquid egg albumen. (Unpublished Ph.D. Thesis, Iowa State College Library, Ames, Iowa, 1946).
12. Stewart, G. F., and Kline, R. W. Dried egg albumen. I. Solubility and color denaturation. *Proc. Inst. Food Technols.*, p. 48 (1941).
13. Stuart, L. S., and Goresline, H. E. Bacteriological studies on the "natural" fermentation process of preparing egg white for drying. *J. Bact.*, 44, 541 (1942).
14. Stuart, L. S., and Goresline, H. E. Studies on bacteria from fermenting egg white and the production of pure culture fermentations. *J. Bact.*, 44, 625 (1942).

Liquid Immersion Freezing of Poultry[a]

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INTEREST IN THE LIQUID IMMERSION FREEZING of poultry has grown rapidly during the last two years and at least four plants in Ontario now use this method. One of the main reasons for this interest is the light colored appearance which can be produced by immersion freezing. Freezing methods giving lighter colored birds have increased in importance with the trend toward higher scald temperatures (138-140° F.) producing reddish birds which darken appreciably on exposure to air and with the increasing use of scientific feeding methods producing birds with relatively little subcutaneous fat. Another advantage of the method is that the high coefficients of heat transfer obtained in liquid as compared to air make more efficient use of refrigeration capacity.

Relatively little information on the immersion freezing of poultry is available. The relation between appearance and freezing rate has been discussed in recent reports *(2, 4, 6)* but these deal mainly with air freezing where freezing rates are much lower than in immersion freezing and the effects which may be produced are not as marked. Esselen, Levine and Pflug, however, noted the "almost white" color produced by freezing in —10° F. brine *(2)* and Esselen, Levine, Pflug and Davis have reported freezing rates obtained in brine at 0° F. and —20° F. *(3)*. Information on the effects of packaging materials and other factors on freezing rates in air *(1)* is of limited use in immersion freezing because the effects of these factors vary widely with freezing rate.

The work outlined in the following report was planned to answer some of the more immediate questions about immersion freezing of poultry:

(1) Factors affecting appearance of frozen birds.
(2) Factors affecting freezing time.
(3) Immersion time required for retention of optimum appearance in birds subsequently placed in an air blast.
(4) Comparison of immersion, liquid spray and air blast freezing.

APPARATUS AND PROCEDURE

Immersion freezing tests were made in 50% (vol.) methanol in a cylindrical 50 gallon tank equipped with a direct expansion cooling coil and a small (⅓₀ h.p.) stirrer that provided sufficient circulation to reduce temperature variations to 1-2° F. A wire frame ensured that all birds were placed in the same position in the tank.

Spray freezing and air blast freezing were also tested. In the spray experiments birds were placed in the spray from 4 nozzles under 20-60 lb. pressure and in the air blast experiments they were placed on open shelves in an air velocity of 300-500 f.p.m.

Except where otherwise noted tests were made with young, 4-6 lb., white-skinned, grade A, 128-130° F. scalded, eviscerated, vacuum packed ("Cry-O-Vac") chickens or with turkeys of similar quality and treatment weighing 14-15 lb. Giblets were wrapped in paper and placed in the body cavity with the neck. Four birds were used in most tests.

Temperatures were measured at the thickest part of the breast and in the body cavity. Thermocouples (30 ga. copper-constantan) were located at the surface (between bag and skin), under the skin, ¼ in., ½ in., and ¾ in. deep in the breast muscle, at the inside surface, and in the giblet package in chickens. The arrangement for turkeys was similar except that elements were located 1 in. and 1½ in. deep instead of ¾ in. deep. A special jig with suitably spaced parallel needles was used to thread the thermocouples through the flesh. Leads were taken out through the end of the bag which was sealed by twisting and tying.

Except where the effect of high initial temperature was studied all birds were frozen from an initial temperature of 32-35° F. and freezing times reported are the times for the temperature to fall from this level to 25° F.

All birds were color graded (Munsell chart) before and after freezing, the "neutral" chart being used for white-skinned birds. To facilitate comparison all birds frozen in each series of tests were stored at —20° F. until the series was completed and then examined together.

RESULTS AND DISCUSSION

Chickens

1. Factors Affecting Appearance of Frozen Birds

The most important factors affecting the appearance of the frozen bird were its initial appearance and temperature, and the liquid temperature. The color of the skin itself did not change during freezing at any temperature, but its opacity did depend on freezing conditions, and the opacity resulting from fast immersion freezing gave white-skinned birds a white, uniform, chalky appearance. Yellow-skinned birds had the same characteristics of opacity and uniformity but the color depended on the amount of yellow pigment in the skin. Birds frozen at +10° F. had a blotchy, somewhat transparent appearance but opacity and uniformity increased with decreasing freezing temperature down to —10 to —20° F. where the appearance of white-skinned birds matched approximately "neutral 9.0" on the Munsell chart. Except for birds initially at 100° F. which required —40° F. freezing for optimum results there was little difference between —20° F. and —40° F. freezing. Surface blemishes such as bruises, or redness due to poor bleeding were reduced in intensity by increased rate of freezing but were not eliminated whereas sub-surface conditions such as lack of fat were masked by the opacity of the skin. Spraying the birds with liquid under prsesure at —10° F. produced approximately the same results as immersion at 0° F.

Weight, within the limits tested (4-6 lb.), scald temperature (128 and 138° F.), and packaging ("Cry-O-Vac") had no appreciable effect on opacity or uniformity of appearance. Hot (138-140° F.) scald, however, does affect the color of yellow birds since the surface layer of skin containing most of the yellow pigment, is removed. Birds frozen without packaging had a somewhat different appearance because the surface was not as smooth as that produced by tight packaging.

The length of time birds retained their original frozen appearance in storage depended on storage temperature. Birds held at +20° F. changed to a light tan color

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within two weeks and birds held at 0° F. had changed slightly after 5-6 weeks but no further changes occurred in the following six weeks. At —20° F. no change occurred in 12 weeks.

2. Factors Affecting Freezing Time

The effect of liquid temperature on freezing time decreased with decreasing liquid temperature and increased with depth in the breast as shown by the slopes of the curves in Figure 1. Although the slope of the

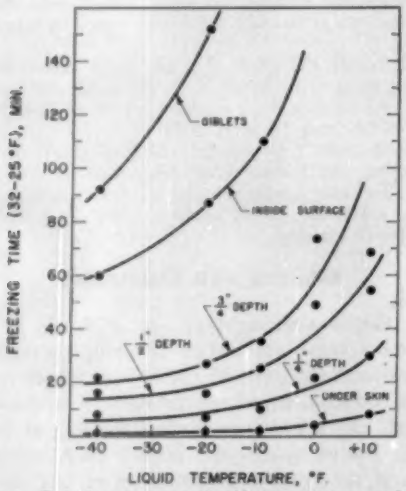

Figure 1. Relation between liquid temperature and freezing time for 4-6 lb. chickens at various depths in breast. (Results are averages for four birds initially at 32-35° F.)

"under skin" curve is small, the freezing time at —20° F. is less than ¼ that at +10° F. and since —20° F. was required to ensure optimum appearance in most of the birds tested, it appears that the skin should be frozen in two minutes or less.

Temperatures measured at the inside surface and in the giblets during freezing at —20° F. indicate that freezing the giblets almost doubles freezing time. This problem could be overcome by relocating the giblets or by freezing them separately.

Increasing the initial temperature of the birds to 100° F. (approximate body temperature after slaughter) increased the freezing time for the skin but reduced freezing time for the inside surface and giblets (compare Figures 2 and 3). This phenomenon was discussed by Long *(5)* who pointed out that freezing time at the center of a slab was maximum for an initial temperature

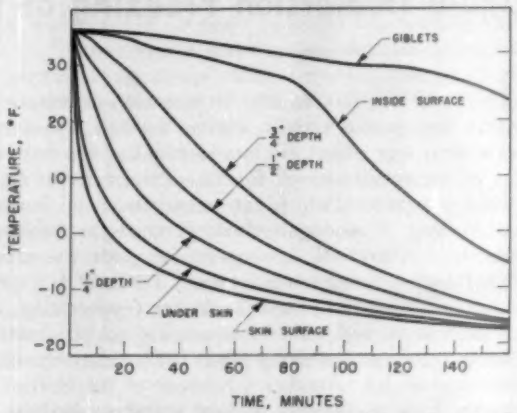

Figure 2. Temperatures at various depths in breast of 4-6 lb. chickens during immersion freezing at —20° F. (Results are averages for four birds.)

of 32° F. Increased freezing time of the skin at 100° F. was confirmed by the difference in appearance previously mentioned. Total immersion time (cooling plus freezing), of course, increases with initial temperature.

Spraying the liquid on the birds rather than immersing them had an effect similar to raising the initial temperature, in that the outside of the bird froze more slowly and the inside more quickly (Table 1). Spray pressure (20-60 p.s.i.g.) did not affect freezing time significantly.

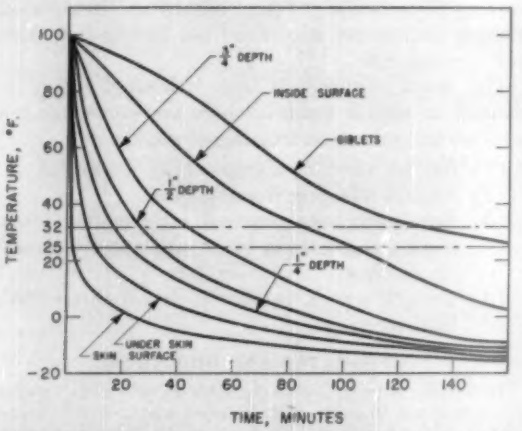

Figure 3. Temperatures at various depths in breast of 4-6 lb. chickens initially at 100° F. during freezing at —20° F. (Results are averages for four birds.)

TABLE 1

Freezing times (32-25° F.) for air blast, liquid immersion and liquid spray (Results are averages of four birds, except for turkeys at —40° F. where two birds were used in each test)

Depth in breast	4-6 lb. Chickens						15 lb. Turkeys		
	Air blast (no bags)		Immersion			Spray	Immersion		Air blast
	—100° F.	—40° F.	—40° F.	—20° F.	10° F.	—10° F.	—40° F.	—20° F.	—40° F.
	(min.)	*(min.)*	*(min.)*	*(min.)*	*(min.)*	*(min.)*	*(min.)*	*(min.)*	*(min.)*
Under skin	8	7	1	2	2	8	2	2	30
¼ in.	16	18	6	9	12	23	6	8	56
½ in.	22	27	14	19	25	38	12	18	83
¾ in.	31	41	20	27	37	48	....	....	....
1 in.	....	....	....	....	....	....	34	54	165
1¼ in.	....	....	....	....	....	....	56	84	180
Inside surface	31	84	60	87	106	96	149	200	310
Giblets	57	110	92	152	205	130	200	270	405

Weight, within the limits tested (4-6 lb.), did not significantly affect freezing time.

The freezing times for unpackaged birds in which the body cavity was sewn shut were not significantly different from the freezing times for "Cry-O-Vac" packaged birds.

3. Partial Immersion Freezing

Twenty minutes was the minimum immersion time at —20° F. which would ensure retention of optimum appearance in birds subsequently placed on open shelves in a —20° F. air blast (300-500 f.p.m.). Some birds retained satisfactory appearance after 10-15 minutes immersion but with 20 minutes all of the birds tested were satisfactory. This immersion time apparently ensured that the skin did not thaw appreciably during the air blast freezing. There was no apparent difference between those finished in an air blast at —20° F. and those finished in an air blast at —40° F.

4. Air Blast Freezing

Although there was little difference between air blast and immersion freezing times in the center of the bird there was marked difference at the surface (Table 1). A —40° F. blast produced birds of fine, light, uniform appearance, but the skin was not as opaque as that of immersion frozen birds. Air blast freezing at —100° F. (dry ice refrigerant) produced birds similar in appearance to those immersion frozen at —20° F. The main effects of packaging were to prevent freezer burn in areas where the skin was damaged and to produce a smooth rather than dimpled appearance.

Turkeys

Liquid freezing affected the appearance of turkeys in much the same way as it affected chickens, a temperature of —20° F. producing optimum results. The outside ½ in. of turkeys and chickens frozen in approximately the same length of time, while the time for complete freezing was approximately proportional to the weight of the birds (compare Figures 1 and 4 and see Table 1). Freezing curves for turkeys in the —20° F. methanol solution are given in Figure 5. Similar freezing times were measured in a propylene glycol solution at the same temperature. In an air blast the surface of turkeys froze much more slowly than that of chickens, but the time for complete freezing was approximately proportional to weight (Table 1).

A 40-minute immersion time at —20° F. was required to ensure retention of optimum appearance in turkeys subsequently placed in an air blast at —20° F. compared to the 20 minutes required for chickens. Presumably a proportionately larger mass of meat remains unfrozen in the larger birds at any given time during the initial stages of freezing.

Reproducibility of Results

Statistical analysis of the results showed that the coefficient of variation for freezing time depended on depth in the bird, ranging from 35-40% for the skin to 10-15% for the inside of the bird. Considering the care with which these tests were made, these variations seem large. Calculations based on the results of the tests indicate that four factors caused most of the variation.

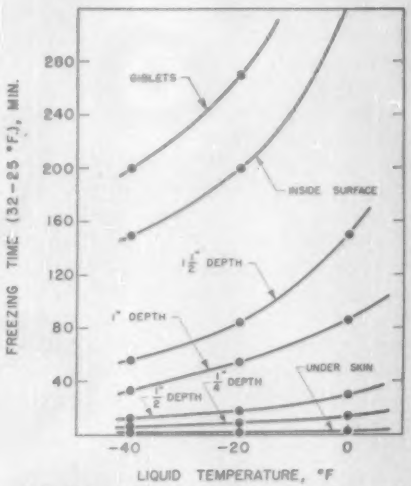

Figure 4. Relation between liquid temperature and freezing time for 15 lb. turkeys at various depths in breast. (Results at —20° F. are averages for four birds; 0 and —40° F. results are averages for two birds.)

(1) Variation in location of temperature measuring elements: in addition to error in initial location, changes may be caused by handling the bird before freezing, and by expansion and contraction due to freezing and thawing.

(2) Variation in packaging: differences in shape due to differences in tightness of packaging, and films of air or water between the packaging film and the skin of the bird may cause variations in freezing time.

(3) Variations in the shape, size and composition of birds: this includes variations in amount and distribution of fat, as well as muscle and bone.

(4) Variation in freezing conditions: although the temperature in the tank was held within close limits, differences in velocity and turbulence of the liquid caused variation of the heat transfer coefficient.

SUMMARY

Optimum appearance of immersion frozen poultry was produced by freezing in a moderately agitated methanol bath at —20° F. The uniform light-colored chalk-like appearance of immersion frozen poultry is

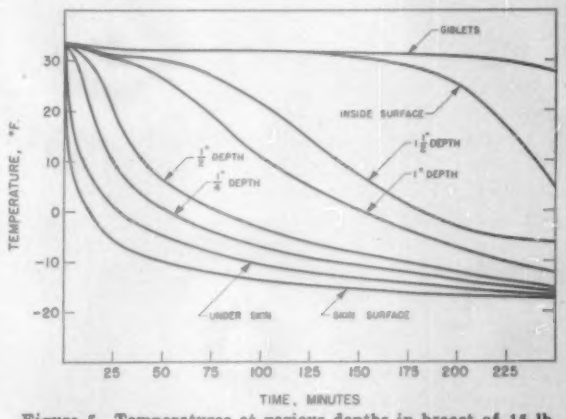

Figure 5. Temperatures at various depths in breast of 15 lb. turkeys during immersion freezing at —20° F. (Results are averages for four birds.)

mainly due to the opacity of the frozen skin rather than to change in the color of the skin.

Immersion times of 20 minutes for 4-6 lb. chickens and 40 minutes for 15 lb. turkeys were required to ensure retention of optimum appearance in birds subsequently placed in an air blast freezer.

Initial temperature of the birds had a marked effect on freezing time and appearance after freezing but "Cry-O-Vac" packaging did not.

Optimum appearance was retained in storage at +20° F. for two weeks, at 0° F. for six weeks (after which a slight change was noticeable) and at —20° F. indefinitely.

Air blast freezing at —100° F. produced an appearance similar to immersion freezing at —20° F. but results from air blast freezing at —40° F. were appreciably different.

Acknowledgment

The authors wish to thank Mr. G. W. Daechsel for assistance in making the tests.

LITERATURE CITED

1. Dunker, C. F., and Hankins, O. G. Rates of freezing and thawing meats. *Food Technol.*, 7, 505-508 (1953).
2. Esselen, W. B., Levine, A. S., and Pflug, I. J. *Food Eng.*, 27 (7) 99 (1955).
3. Esselen, W. B., Levine, A. S., Pflug, I. J., and Davis, Lyle L. *Refrig. Eng.*, 62 (7) 61-63 (1954).
4. Klose, A. A., and Pool, M. F. Effect of freezing conditions on appearance of frozen turkeys. *Food Technol.*, 10, 34-38 (1956).
5. Long, R. A. K. *J. Sci. Food Agr.*, 6, 621-633 (1955).
6. Spencer, J. V., Matson, W. E., Stadleman, W. J., and Ahrens, M. C. The effect of cooling and freezing procedures on consumer acceptability factors of turkey meat. *Food Technol.*, 10, 16-18 (1956).

Effect of Addition of Monosodium Glutamate on Palatability of Frozen Vegetables

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Addition of monosodium glutamate to various foods including vegetables has been a subject of considerable interest in recent years. Sjöström and Crocker *(6)* reported that the addition of monosodium glutamate in varying ranges improved the flavor of cooked fresh, canned, and frozen vegetables. Girardot and Peryam *(1)*, on the other hand, observed no significant preference for samples of cooked frozen peas and lima beans to which monosodium glutamate had been added, although most canned vegetables containing monosodium glutamate were preferred to the untreated controls.

Hac, Long, and Blish *(2)* found that freshly picked young peas and corn, cooked and analyzed within 6 hours of harvest, contained more naturally occurring free glutamic acid than did more mature vegetables from the same fields. They stated that 25-35% of the free glutamic acid in raw vegetables was lost during refrigerator storage, almost all of the loss taking place in the first 24 hours.

Shuey and Eichenberger *(5)* reported that the addition of monosodium glutamate to certain vegetables before freezing resulted in improved flavor after 2 to 3 months of freezer storage. Norton, Tressler, and Farkas *(3)* added 0.15% (by weight) monosodium glutamate to vegetables frozen under commercial conditions. The vegetables tested included broccoli, corn, peas, cut green beans, and spinach as well as a number of others. They found that after 10 months of storage the flavor of all glutamate-treated vegetables was preferred to that of the untreated controls. Statements were also made that the green vegetables with added monosodium glutamate had better color and that the peas with monosodium glutamate were more tender than untreated vegetables.

Pilgrim, Schutz, and Peryam *(4)* used three types of palatability measurements to evaluate the effects of monosodium glutamate on taste acuity and flavor perception. Their results supported the hypothesis that monosodium glutamate alters flavor in a way similar to other seasonings rather than by some unusual effect on sensory acuity.

The study herein reported was undertaken to find out if the addition of monosodium glutamate to freshly harvested vegetables frozen under conditions closely approximating those found in the home would improve the palatability of the stored frozen products. The effect of adding crystalline monosodium glutamate or one of the commercial monosodium glutamate preparations was investigated in five cooked and cooked stored frozen vegetables.

EXPERIMENTAL PROCEDURE

Vegetables used in this study were grown under the supervision of the Department of Horticulture, University of Illinois. Work was done in 1953 with De Cicco and Green Mountain broccoli; Carmel Cross, Double Duty, Gold Rush, Hybrid 51, Hybrid 198, Hybrid 199, Iochief, Plain Gold, Seneca Warrior, and Victory Golden corn; Burpeeana Early Dwarf, Large Podded Little Marvel, and Thomas Laxton Green Pod peas; Improved Commodore snap beans; and Blight Resistant Savoy spinach. The next year the varieties and vegetables included were De Cicco broccoli, Victory Golden corn, Thomas Laxton peas, Improved Commodore snap beans, and Bloomsdale Savoy Long Standing spinach. The vegetables were harvested at stages of maturity suitable for freezing and were brought to the foods research laboratory for processing on the days on which they were picked. The vegetables were of good quality except for the snap beans used in 1954 which were adversely affected by a poor growing season.

During the first year of the study each variety of broccoli, corn, and peas was processed once or twice, depending upon the amounts available. Snap beans and spinach were prepared for freezing on 4 different days. In 1954, the work on all vegetables except broccoli was replicated on 4 different days, while the work on broccoli was replicated 3 times.

Preliminary treatment. Vegetables were carefully sorted and any substandard material was discarded. Tough portions of the stalks of broccoli and stems of spinach were cut off. These

vegetables were washed thoroughly and allowed to drain; then they were shaken and partially dried on towels. Husks and silks were removed from the corn, and the peas were shelled before washing and drying. Snap beans were washed and dried, the cap and stem ends were removed, and the beans were cut into 1 inch pieces.

Blanching. Weighed amounts of all vegetables except corn were tied up in single layers of cheesecloth so that they were contained in loose bags. These bags and weighed amounts of corn were placed in blanching baskets which were lowered into varying volumes of boiling water. Details of the blanching procedures are summarized in Table 1. Immediately after

TABLE 1
Blanching procedures

Vegetable	Weight in g. of vegetable blanched at one time	Weight in g. of vegetable in each bag	Quarts of boiling water used for blanching	Length of blanching period in minutes	Average temperature of water at end of blanching period
Broccoli	540	180	6.0	3	99° C.
Corn	ca 4000	.....	12.0	8	93° C.
	ca 3000	.....	9.0	8	97° C.
Peas	900	300	6.0	1	91° C.
Snap beans	960	240	6.4	3	96° C.
Spinach	900	450	8.0	1	92° C.
	450	450	4.0	1	94° C.

blanching, the vegetables were immersed in a container of cold water and cooled in cold running tap water—corn for 8 minutes and the other vegetables for 3. They were drained at once, and the excess moisture was removed with towels. The corn was then cut from the cob. On a given day the blanching operation was repeated to provide a quantity of vegetable sufficient for the treatments outlined below.

Treatments. On each day of processing in 1953, 4 control samples were packaged without further treatment. Each one of 4 other samples was placed in a bowl, dusted with 0.15% (by weight) monosodium glutamate, mixed thoroughly, and packaged. In some cases additional samples were prepared with 0.30% monosodium glutamate in the same manner. Broccoli was treated with 0.20% monosodium glutamate which was added after the vegetable was placed in the package. In 1954 similar procedures were followed except that on each day of processing, 3 control samples were prepared, 3 samples were treated with 0.15% monosodium glutamate, and 3 samples were treated with 0.15% of the commercial preparation of monosodium glutamate, Ac'cent.[a] Throughout the study, the vegetables were packaged in pint cardboard containers with heat-sealable cellophane bags attached inside. As soon as the packages were sealed they were placed in the refrigerator and held until all samples prepared that day could be transported to the freezer.

Freezing and freezer storage. Samples were placed in a plate-type freezer and allowed to remain for approximately 20 hours. Temperature on the plates ranged from —24° to —30° C. (—11.2° to —22.0° F.). Containers were then transferred to freezer storage where the temperature was —17.8° C. ± 2.8° (0° F. ± 5.0°). Samples were held in freezer storage for 1, 3, 6, and 9 months in 1953 and for 3, 6, and 9 months in 1954 before being cooked for evaluation of palatability.

Cooking. Cooking procedures for the fresh and stored frozen vegetables were established and followed throughout the study. The vegetables were placed in small amounts of boiling distilled water and cooked until just tender. Salt was the only seasoning used in cooking all samples. On the day each lot of a vegetable was harvested and prepared for freezing, a fresh control sample was cooked for taste tests and additional fresh samples were cooked with monosodium glutamate or Ac'cent at the same levels as were used for the samples being frozen. The monosodium glutamate or Ac'cent was dusted on the vegetable immediately after it was added to the boiling cooking water.

Organoleptic ratings. Coded samples of the hot, cooked vegetables were judged by a taste panel of 4 members of the foods research staff. Due to changes in personnel the membership of the panel was not the same throughout the 2 years. Appearance, color, texture, flavor, and absence of off-flavor of the vegetables were each rated according to a scale in which 5 corresponded to *very good;* 4, *good;* 3, *fair;* 2, *poor;* and 1, *very poor.*

Total palatability scores were then obtained by adding the scores given to these individual quality factors. Mean total palatability scores and mean scores for individual characteristics were determined by averaging the judges' scores for the replicate samples. Differences between control and treatment scores for each palatability factor and for total palatability were tested for significance by calculating Student's t for paired data.[b]

RESULTS AND DISCUSSION

Mean total palatability scores for the snap beans and spinach harvested and frozen in 1953 are presented in Table 2. Comparison of the ratings for these cooked fresh and stored frozen vegetables with and without added monosodium glutamate indicates that addition of monosodium glutamate did not improve the palatability of the products. On the contrary, the snap beans with 0.15% monosodium glutamate were rated significantly lower after 6 and 9 months of freezer storage than were controls which were packed plain, and the snap beans with 0.30% added monosodium glutamate were rated significantly lower than the controls after 3, 6, and 9 months. The spinach with 0.15% monosodium glutamate received scores which were significantly lower than the control scores after 1, 3, and 9 months of storage. The treated samples were scored lower on the characteristics of flavor and absence of off-flavor which decreased the total palatability ratings accordingly. There were no significant differences for ratings of appearance, color, or texture between treated and untreated samples of either vegetable.

Experimental data for the varieties of broccoli, corn, and peas frozen with and without monosodium glutamate in 1953 are not included because the work on each

[a] Mention of commercial products by brand name is for identification only and does not constitute endorsement by IFT over other commercial products in the same category.

[b] $$t = \frac{\Sigma D}{\sqrt{\frac{n}{n-1}\left[\Sigma D^2 - \frac{(\Sigma D)^2}{n}\right]}}$$

Where n is the number of pairs and D is the difference between members of a pair.

TABLE 2
Mean total palatability scores for two vegetables frozen in 1953

Vegetable	Mean total palatability scores for cooked vegetables														
	Freshly harvested			Frozen and stored 1 month			Frozen and stored 3 months			Frozen and stored 6 months			Frozen and stored 9 months		
	Plain (controls)	0.15% MSG added	0.30% MSG added	Plain packed (controls)	0.15% MSG added	0.30% MSG added	Plain packed (controls)	0.15% MSG added	0.30% MSG added	Plain packed (controls)	0.15% MSG added	0.30% MSG added	Plain packed (controls)	0.15% MSG added	0.30% MSG added
Snap beans	21.8	21.6	21.6	21.6	21.4	20.9	21.7	21.1	20.0**	20.9	19.9**	18.9**	20.9	19.8*	19.5**
Spinach	23.6	23.6	.....	22.5	21.5**	.....	22.1	21.3*	.....	21.8	21.2	.....	22.1	21.5**	.....

* Scores are significantly different from scores for plain samples at 5% level.
** Scores are significantly different from scores for plain samples at 1% level.

TABLE 3
Mean total palatability scores for five vegetables frozen in 1954

Vegetable	Mean total palatability scores for cooked vegetables											
	Freshly harvested			Frozen and stored 3 months			Frozen and stored 6 months			Frozen and stored 9 months		
	Plain (controls)	0.15% MSG added	0.15% Ac'cent added	Plain packed (controls)	0.15% MSG added	0.15% Ac'cent added	Plain packed (controls)	0.15% MSG added	0.15% Ac'cent added	Plain packed (controls)	0.15% MSG added	0.15% Ac'cent added
Broccoli	18.9	19.5	18.7	21.6	21.3	21.5	19.7	19.8	19.9	19.8	20.3	20.3
Corn	23.0	22.2	22.8	21.6	21.5	21.4	21.6	21.4	21.8	20.6	20.5	20.1
Peas	22.8	22.5	22.7	21.4	21.5	21.7	21.1	21.2	21.4*	20.3	20.3	20.0
Snap beans	20.9	20.9	21.0	20.3	20.9	21.1**	19.1	19.9	19.9	18.0	18.8**	18.6
Spinach	23.7	23.1	23.2	21.3	21.6	21.7	20.9	21.0	21.1	20.6	20.8	21.0

* Scores are significantly different from scores for plain samples at 5% level.
** Scores are significantly different from scores for plain samples at 1% level.

variety was replicated only once or twice. However, the mean total palatability ratings obtained for 2 varieties of broccoli, 10 of corn, and 3 of peas whether cooked fresh or cooked after several periods of freezer storage failed to indicate any enhancement of palatability due to the addition of 0.15% monosodium glutamate.

Mean total palatability scores for the broccoli, corn, peas, snap beans, and spinach frozen in 1954 are given in Table 3. There were no significant differences in total palatability between plain packed samples of broccoli, corn, or spinach and samples containing 0.15% monosodium glutamate or 0.15% of the commercial preparation, Ac'cent. However, peas with added Ac'cent were rated higher after 6 months of freezer storage, while the scores of snap beans plus Ac'cent after 3 months of storage and of snap beans with added monosodium glutamate after 9 months of storage were significantly higher than those of the corresponding controls.

In regard to the scores for the individual factors of palatability no significant differences in appearance or texture were found between treated and untreated samples of any of the vegetables. Snap beans were the only vegetable which showed any effect of monosodium glutamate on color. With added Ac'cent the color score was higher than that of the plain packed snap beans at the 1% level of significance after 3 months of freezer storage and at the 5% level after 6 months of storage, while snap beans with added monosodium glutamate received higher color ratings than the controls at the latter level after 3, 6, and 9 months of freezer storage. Neither monosodium glutamate nor Ac'cent had a significant effect on the flavor or absence of off-flavor scores in corn, peas, or snap beans. Broccoli with added monosodium glutamate was rated higher in flavor than was the control after 6 months of storage, and spinach with monosodium glutamate was rated higher in flavor than the untreated after 9 months. Cooked fresh broccoli with monosodium glutamate was considered to have less off-flavor than the plain broccoli whereas cooked fresh spinach with the same additive had more off-flavor than the untreated spinach. These differences were significant at the 5% level.

The addition of monosodium glutamate to these 5 vegetables did not produce any consistent differences in the mean palatability ratings of the treated and untreated samples. Although the 1954 snap beans, which were of rather poor initial quality, were improved to a limited extent by monosodium glutamate, the same variety of beans frozen in 1953 was less palatable when monosodium glutamate was added. The 1953 spinach also showed undesirable effects as a result of the addition of monosodium glutamate. These results differ from those obtained by Norton, Tressler, and Farkas *(3)* who reported that monosodium glutamate in the amounts employed here improved the quality of all the frozen vegetables tested. However, in view of the work of Hac, Long, and Blish *(2)* it seems possible that the vegetables used in the present study may have had a higher level of naturally occurring free glutamic acid than samples selected from a commercial processing line *(3)* since they were harvested at optimum maturity and processed immediately. If monosodium glutamate acts as a seasoning as proposed by Pilgrim, Schutz, and Peryam *(4)* and the level of free glutamic acid in a vegetable varies according to the vegetable, the maturity, and the holding conditions *(2)*, the fact that different results were obtained in the 2 years of the present study and by different workers seems understandable.

SUMMARY

In the majority of comparisons the addition of 0.15% crystalline monosodium glutamate or the commercial preparation Ac'cent did not improve the total palatability scores or the scores of individual palatability factors for cooked fresh or cooked stored frozen broccoli, corn, peas, snap beans, and spinach. Although the differences between treated and untreated samples were significant in a few instances, neither the increases nor decreases in the scores were large enough to be of practical importance. These results preclude recommending the addition of monosodium glutamate during the preparation of freshly harvested vegetables of optimum quality for serving or for freezing.

LITERATURE CITED

1. Girardot, N. F., and Peryam, D. R. MSG's power to perk up foods. *Food Eng.*, **26** (12), 71 (1954).
2. Hac, L. R., Long, M. L., and Blish, M. J. The occurrence of free L-glutamic acid in various foods. *Food Technol.*, **3**, 351 (1949).
3. Norton, K. B., Tressler, D. K., and Farkas, L. D. The use of monosodium glutamate in frozen foods. *Food Technol.*, **6**, 405 (1952).
4. Pilgrim, F. J., Schutz, H. G., and Peryam, D. R. Influence of monosodium glutamate on taste perception. *Food Research*, **20**, 310 (1955).
5. Shuey, G. A., and Eichenberger, W. R. Monosodium glutamate sharpens flavor of quick frozen foods. *Quick Frozen Foods*, **13** (12), 59 (1951).
6. Sjöström, L. B., and Crocker, E. C. The role of monosodium glutamate in the seasoning of certain vegetables. *Food Technol.*, **2**, 317 (1948).

*

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FOOD INDUSTRY TOPICS . . .

. . . in the public interest

Automation has come in for a lot of attention in recent months, with reactions ranging from the alarmist to the "it's really nothing new" attitude. Now the Milton Roy Co. has published an address by its president, Robert T. Sheen, on "Automation . . . An Indispensable Tool of Man." Originally presented before the New York City Rotary Club, Mr. Sheen's address summarizes many of the points he later made during an appearance at hearings of the Congressional Subcommittee on Economic Stabilization. He points out that Iron Curtain countries may well have us at a disadvantage. With their greater emphasis on technical training, they may be long strides ahead of us before we can train the workers necessary to design, build, install, service and supervise automatic equipment. Copies of a booklet containing Mr. Sheen's remarks are available from Milton Roy Co., 1300 E. Mermaid Lane, Philadelphia 18.

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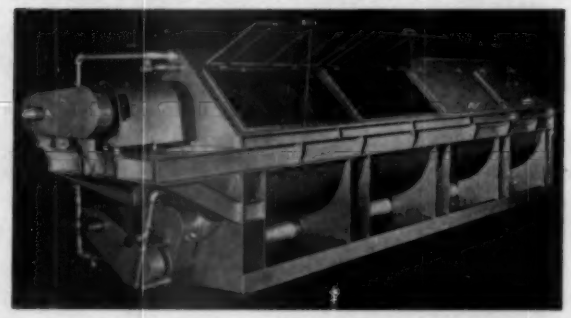
In an effort to alleviate the shortage of technical manpower, a Technical Personnel Recruiting Exposition has been scheduled for June 8-12 in Chicago. The exposition, which will be held in conjunction with the National Technical Career Conference, will feature exhibits by leading research and manufacturing organizations. Exhibitors will offer a wide selection of professional opportunities. Prospective technical employees will be offered complete information about available jobs and the companies behind them. Although there is no charge to registrants, those who wish to attend must register in advance. Registration forms and the bulletin "How to Prepare an Effective Work Experience Resumé" can be obtained by writing Marcus W. Hinson, Director, Technical Career Conference, 19 S. LaSalle St., Chicago 3.

. . . things new under the sun



A vegetable blancher, said to be capable of meeting the most rigid sanitary requirements in the industry, has been introduced by the Canning Machinery Division of Food Machinery & Chemical Corp. Called the FMC Sani-Flow blancher, the machine consists of a round-bottom, shell-and-hood combination housing a perforated spiral screw. The product is conveyed through the machine by recirculating water while the spiral screw, which revolves at a predetermined rate, controls in-process time. The screw also facilitates handling of the product by giving a positive, continuous discharge from the machine. FMC says that the machine is designed to provide thorough cleaning, gentle product handling, and retention of constant water temperature during operation. A series of hinged doors is installed on each side of the hood section, making it possible to clean all areas of the interior thoroughly. Constant water temperature is maintained by steam jets that feed into the blancher shell and the water-return tube. All parts that contact the product are made of stainless steel. Full details on the Sani-Flow blancher can be obtained from Food Machinery & Chemical Corp., Canning Machinery Division, P. O. Box 1120, San Jose, Calif., or 103 E. Maple St., Hoopeston, Ill.

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American Optical Company's Instrument Division has announced that it is now marketing the Goldberg process refractometer. The company says the device has already proven itself a success in control of soluble solids in turbid, dark-colored concentrates that are likely to occur in the manufacture of such products as jellies, jams, purees, juices and syrups. Three models offer Brix ranges of 0-25%, 12-75% and 36-82%. Any of these may be installed either in the wall of a process vessel or in any other location where continuous readings are required. The instrument is designed to withstand pressures up to 20 p.s.i. and temperatures up to 110° C. (230° F.). The company claims these advantages for the Goldberg refractometer: withdrawal of a sample is not necessary; evaporation errors are eliminated; readings are unaffected by foam, air bubbles, viscosity and pulp; and no operator training period is required. Accuracy range of the instrument is said to be 0.25-0.50%. Complete information is available from American Optical Company, Instrument Division, Buffalo 15, N. Y.

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Two new models of vacuum brining tanks, simplified in construction to provide better sanitation, are being offered to apple processors. Called Lee vacuum brining tanks, they are made in 325- and 525-gal. sizes, of either Type 304 or Type 316 stainless steel. They may be used either singly or in battery. The smaller tank is 42 in. in diameter and 115 in. high; the 525-gal. model is 48 by 133 in. The manufacturer, Lee Metal Products Co., Philipsburg, Pa., offers Supplement No. 2 to Bulletin LM-8, giving all details on the two models.

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A new "double-check" organoleptic testing service is being offered to food processors by the antioxidant

(Continued on page 35)

taste appeal for the calorie-conscious *equals* specialty food sales!

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(Continued from page 30)

laboratories of Eastman Chemical Products, Inc. Because organoleptic evaluations are to a great degree a matter of opinion, Eastman has arranged that the processor himself become part of the panel of testers. Whenever possible, the company plans to treat products sent to its laboratories with the appropriate antioxidant and then return a portion of the treated and control samples to the processor, who can judge the influence of the antioxidant along with Eastman's own testing panel. Details about the program can be obtained by writing Eastman Chemical Products, Inc., 260 Madison Ave., New York 16.

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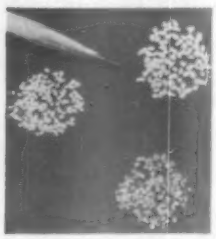
A special topping salt—refined by the Alberger process and said to be 99.95% pure—has been put on the market especially for pretzel bakers. Developed with the cooperation of the National Pretzel Bakers Institute, the new product is also designed for use on breads, hard rolls and salt bread sticks. A finer screening is available for crackers. The producer, Diamond Crystal Salt Co., St. Clair, Mich., claims that while particular attention is given to the purity of the product, equal emphasis is placed on firmness of grain, uniformity of size, appearance and flavor. The illustration compares Pretzel M (medium), top, and Pretzel F (fine), left, with ordinary rock salt, lower right. The grain of the new salts is said to have proved itself under test conditions to be sufficiently hard to withstand shipping, handling, dispensing through salting machines and high-temperature baking.



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Big plants that require a large supply of dry compressed air are offered a specially designed Aero-After-Cooler with a self-contained method of cooling and drying compressed air. The machine also combines provision for cooling water in a closed system for intercooler and compressor jackets. Consisting of two parallel-mounted cooling coils (one for compressed air and one for jacket water) mounted on either side of a central chamber, the Aero-After-Cooler is designed to transfer heat of compression at the rate of about 1,000 BTU per pound of water evaporated. The air stream is ejected upward from the central chamber by a propeller fan. The manufacturer says that compressed air is always cooled below the outside air temperature, so no further condensation can take place in exposed air distribution lines; jacket water is cooled to the optimum temperature by regulating the intake of outdoor air with dampers. Niagara Blower Co., 405 Lexington Ave., New York 17, offers the Aero-After-Cooler in four sizes with capacities up to 23,000 c.f.m. Detailed specifications can be obtained from the company.

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An indicating pressure transmitter, compact in size and said to be accurate within 1% of the scale range, is being offered by the Foxboro Co., Foxboro, Mass. The instrument is designed for pneumatic transmission of process pressure measurements. It measures pressures of 0-30 in. of water to 0-6,000 p.s.i., transmitting a 3-15 p.s.i. air signal to remote indicating, recording or controlling instruments. Adaptation to the various pressure ranges is made by choosing from a variety of standard Foxboro pressure elements. Known as the Model 44 pressure transmitter, the instrument eliminates the need for a separate field gauge, since it has an indicating scale, 4⅛ in. long, built into the front of its case. Complete information and specifications can be obtained from the manufacturer.

◆ ◆ ◆

An imitation nutmeg has been devised in retaliation for the misdeeds of a hurricane. When the storms of 1955 wiped out most of the natural nutmeg grown in Grenada, British West Indies, Knickerbocker Mills Co. chemists went to work to produce an acceptable substitute. Flavor, texture and aroma of the new imitation spice that came out of this work are excellent—judged by company officials to be as close to those of the natural product as it is possible to perfect. Said to be nearly impossible to differentiate between the two products in use, the synthetic nutmeg is being offered at about one-half the price of the company's natural nutmeg. Information is available from Knickerbocker Mills Co., 601 W. 26th St., New York 1.

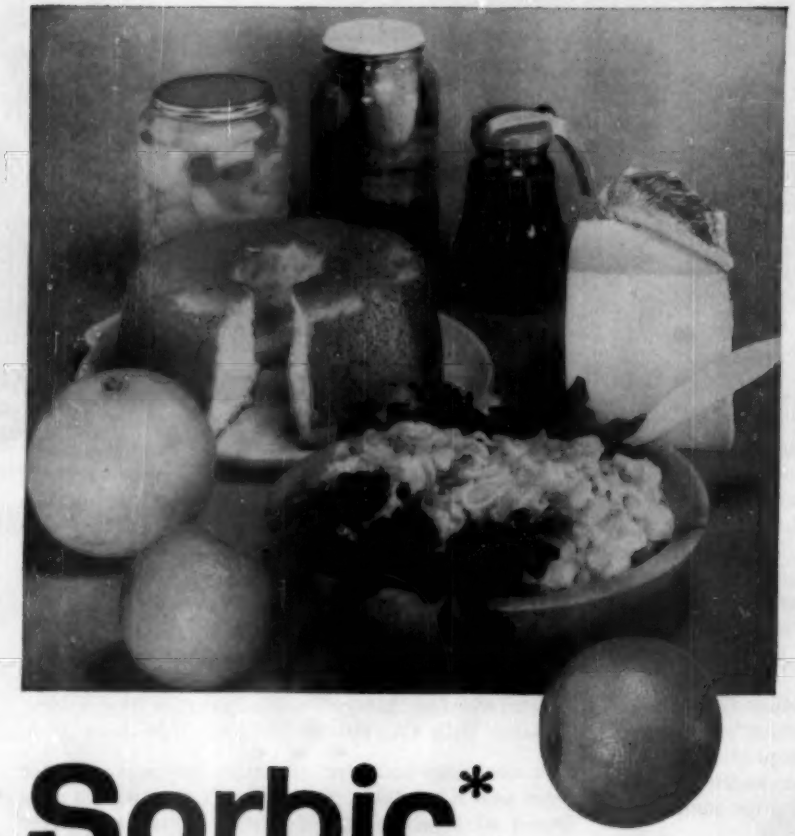
◆ ◆ ◆

A one-piece unit for operating laboratory water baths now is available. Called the Tempunit, it is comprised of a self-contained heater, controller, stirrer and circulator, with a built-in pneumatic control system sensitive within a range of 0.1° C. The stirrer, which rotates inside the heating coil, provides the air supply for the bimetallic, helical, temperature-sensing element, which operates a pneumatic capsule. Suction produced by the stirrer also enables the Tempunit to circulate one liter per minute to external instruments such as refractometers and viscosimeters, while closely controlling an uninsulated four-gal. water bath. The 1,000-watt immersion heater is of the tubular type, wound in a helix. The case dimensions of the Tempunit, which weighs 5½ lbs., are 5½ x 4½ x 3½ in. It can be attached to any size container by a rubber-cushioned clamp. Specifications and additional information can be had from Arthur S. LaPine & Co., 6001 S. Knox Ave., Chicago 29.

◆ ◆ ◆

Continental Can Co. announces it has developed a new linear-type polyethylene bottle that is able to withstand sterilization at 250° F. for 30 minutes. The bottle, developed by the company's Plastic Container Division, is intended for foods, pharmaceuticals and cosmetics, and is said to combine the safety feature of unbreakability while retaining all sanitary advantages. The Division of Pharmacology of the U. S.

(Continued on page 43)



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SELECTED ABSTRACTS . . .

Compiled by H. A. Campbell

ANALYTICAL METHODS

Estimation of α-keto acids in plant tissue: a critical study of various methods of extraction as applied to strawberry leaves, washed potato slices and peas.

ISHERWOOD, F. A. (Univ. of Cambridge). *Biochem. J., 64,* 549-58 (1956).

In the recommended method, the tissue was frozen in a mixt. of MeOH and solid CO_2 and then disintegrated in 0.6*M* metaphosphoric acid at −2°.

Mass spectrometric determination of volatile solvents in industrial waste water.

HAPP, G. P., STEWART, D. W., AND COOPER, H. C. (Eastman Kodak Co., Rochester, N. Y.). *Anal. Chem., 29,* 68-71 (1957).

Trace amts. of volatile org. solvents present in waste H_2O can be identified and detd. directly with the mass spectrometer. Since it is not desirable to admit sewer H_2O directly to the spectrometer inlet system, the vapor phase in equil. above the liquid, in an air-free system, is sampled and admitted. Two methods, one static and the other continuous, are used.

Determination of antioxidants in edible fats.

ANGLIN, C., MAHON, J. H., AND CHAPMAN, R. A. (Dept. of Natl. Health and Welfare, Ottawa, Canada). *J. Agr. Food Chem., 4,* 1018-22 (1956).

Methods are presented for detg. the antioxidants, butylated hydroxytoluene (BHT), butylated hydroxyanisole (BHA), propyl gallate (PG), nordihydroguaiaretic acid (NDGA), and all combinations except those contg. both propyl gallate and nordihydroguaiaretic acid.

BIOLOGICAL SCIENCES

BIOCHEMISTRY

Studies on the metabolism of amino acids and related compounds in vivo. II. Effect of toxic doses of essential amino acids on blood sugar, liver glycogen and muscle glycogen levels.

WINITZ, M., GULLINO, P., GREENSTEIN, J. P., AND BIRNBAUM, S. M. (Dept. Health, Education and Welfare, Bethesda, Md.). *Arch. Biochem. and Biophys., 64,* 333-41 (1956).

There is no apparent relationship between the toxicity of amino acids and the effect of these compounds on the blood sugar level. The hypoglycemia induced in treated animals cannot be attributed either to storage of glucose as liver or muscle glycogen or to abnormal excretion of glucose in the urine.

A new synthetic substrate for trypsin and its application to the determi-

nation of the amino acid sequence of proteins.

LINDLEY, H. (Ind. Research Organization, Parkville, N. 2, Victoria, Australia). *Nature, 178,* 647-8 (1956).

Trypsin generally catalyzes the hydrolysis of lysine peptides more efficiently than others. S-(β-aminoethyl-) cysteine is almost identical to lysine in the spatial relations of its functional groups. The novel idea of converting the cysteine residues of keratin to S-(β-aminoethyl-) derivs. for structural studies with trypsin was presented. It was shown that trypsin does split S-amino-ethylcysteine residues from a polymer of such residues. The chromatographic behavior of these residues and lysine is strikingly similar.

The amino acid sequence at the *N* terminus of pepsin.

WILLIAMSON, M. B., AND PASSMANN, J. M. (Loyola Univ., Chicago, Ill.). *J. Biol. Chem., 222,* 151-7 (1956).

The *N*-terminal sequence of pepsin was studied with the use of the technique for the stepwise degradation of peptides with the formation of phenyl thiohydantoins and the technique for the labeling of the terminal amino acid of a protein with dinitrofluorobenzene. The terminal sequence was found to be Leu-Gly-Asp-Asp-His-Glu.

Urea as a source of nitrogen for the biosynthesis of amino acids.

ROSE, W. C., AND DEKKER, E. E. (Univ. of Illinois, Urbana, Ill.). *J. Biol. Chem., 223,* 107-21 (1956).

The data are believed to provide unequivocal proof that the N of urea can be utilized for the synthesis of the nonessential amino acids when the latter are excluded from the food, and when no other source of N is available for the purposes in question. The probable role of bacteria in the utilization of urea N is discussed.

Pancreatic elastase: purification, properties, and function.

LEWIS, U. J., WILLIAMS, D. E., AND BRINK, N. G. (Merck & Co., Rahway, N. J.). *J. Biol. Chem., 222,* 705-19 (1956).

Observations on the occurrence, purification, enzymatic function, and phys. and chem. nature of homogeneous procine elastase are given. A simple and reproducible isolation procedure for substantially pure cryst. porcine elastase from commercially available starting materials is described.

Oxygen removal prevents rancidity in mayonnaise.

BLOOM, J., SCOFIELD, G., AND SCOTT, D. (Continental Coffee Co.) *Food Packer, 16**, December 1956.

Glucose oxidase-catalase shows promise in increasing the shelf-life of mayonnaise. This enzyme combination is claimed to remove the O_2 from mayonnaise which tends to retard the rancidity of the fat.

Nonenzymic browning reactions and their physiological effects. I.

CREMER, H. D., AND MENDEN, E. (Johannes Gutenberg Univ., Mainz, Ger.). *Z. Lebensm.-Untersuch. u-Forsch., 104,* 33-43 (1956); *Chem. Abstr., 50,* 17223e (1956).

The reaction of protein and reducing sugar is reviewed with regard to capability of reaction, mechanism, structure, and reduction of nutritive value of casein, lactalbumin, milk, cereal protein, soybean meal, and meat by this reaction.

Algae as sources of lysine and threonine in supplementing wheat and bread diets.

HUNDLEY, J. M., ING, R. B., AND KRAUSS, R. W. (Natl. Inst. of Health, Bethesda, Md.). *Science, 124,* 536-7 (1956).

Data indicate that algae protein may have considerable potential application as a source of amino acids that are generally low in cereals.

Evolution of protein molecules and thermal synthesis of biochemical substances.

FOX, S. W. (Oceanographic Inst., The Florida State Univ.). *Am. Scientist, 44,* 347-59 (1956).

A discussion of the theory that biochemistry recapitulates pyrochemistry with particular emphasis on the formation and function of proteins.

The function of phospholipids.

BEVERIDGE, J. M. R. *Can. J. Biochem. & Physiol., 34,* 361-71 (1956); *Food Sci. Abstr., 28,* No. 1523 (1956).

It appears probable that phospholipids are in some way involved in the resynthesis of triglycerides during the absorption of fat, but this cannot be considered as definitely proved. Evidence has been obtained against the theory that phospholipids are a vehicle for the transport of fatty acids, but there are good reasons for assigning to β-lipoprotein, of which phospholipids are integral constituents, an important part in the transport of neutral fat. Evidence is available in support of the theory that choline-contg. phospholipids, probably lecithins, facilitate the oxidation of fatty acids.

Water-soluble constituents of fruit. IV. The organic acids in peaches.

ANET, E. F. L. J., AND REYNOLDS, T. M. (Div. of Food Preservation and Transport, Homebush, Australia). *Austral. J. Chem., 8,* 280-4 (1955); *Z. Lebensm. Untersuch, u.-Forsch., 104,* 384 (1956).

1-quinic, 1-malic and citric acids were isolated and detd. as 90% of total acids. Smaller amts. of the following acids were found: phosphoric (5%), galacturonic (only in ripe fruits up to 6%) and numerous other acids including mucic (total of 2-3%). The amts. of the 3 main acids in peaches are related to variety, climatic conditions and degree of maturity.

The effects of salicylic acid and related compounds on in vitro rat brain respiration.

PENNIALL, R., KALNITSKY, G., AND ROUTH, J. I. (State Univ. of Iowa, Iowa City). *Arch. Biochem. and Biophys., 64,* 390-400 (1956).

The compds. aspirin, salicylic acid, gentisic acid, and salicyluric acid were

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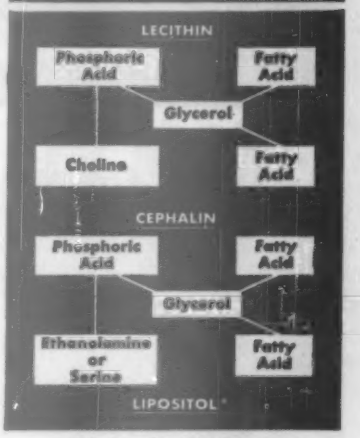

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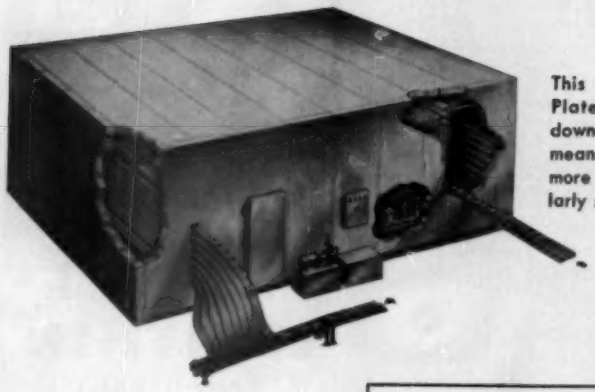

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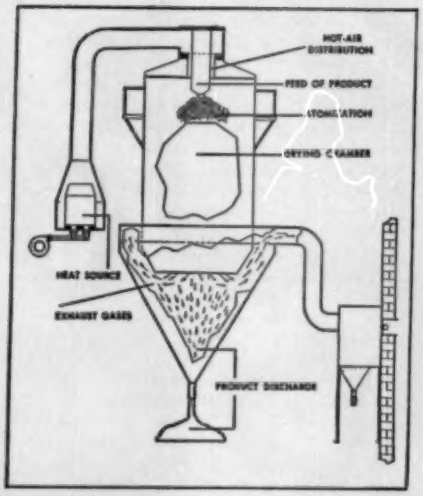

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found to inhibit *in vitro* brain glycolysis. Salicylic acid was found to uncouple oxidative phosphorylation from O_2 uptake during the oxidation of pyruvate by both homogenates and mitochondria of brain tissue. A similar effect was observed for salicylic acid on the oxidation of succinic acid by brain mitochondria.

MICROBIOLOGY

Natural synthesis of low molecular weight (clinical type) dextran by a Streptococcus strain.

HEHRE, E. J. (Cornell Univ., Med. Coll., N. Y.). *J. Biol. Chem., 222,* 739-50 (1956).

Paper describes a novel bacterial dextran of a mol. wt. lower than that of the native dextrans obtained as major products from *Leuconostoc mesenteroides* or other species.

Effects of dietary antibiotics upon numbers and kinds of intestinal bacteria in chicks.

WIESMAN, R. F., SARLES, W. B., BENTON, D. A., HARPER, A. E., AND ELVEHJEM, C. A. (Univ. of Wisconsin, Madison). *J. Bacteriol., 72,* 723-4 (1956).

Additional information was obtained which substantiates the theories of "vitamin-sparing" and "enhancement of vitamin-synthesizing bacteria" by dietary antibiotics.

NUTRITION

Biological effects of the polymeric residues isolated from autoxidized fats.

KAUNITZ, H., SLANETZ, C. A., JOHNSON, R. E., KNIGHT, H. B., SAUNDERS, D.H., AND SWERN, D. (Inst. of Research in Animal Diseases, Columbia Univ., N. Y.). *J. Am. Oil Chemists' Soc., 33,* 630-4 (1956).

Diets contg. 20% of autoxidatively produced polymeric residue, fed to albino rats, led to diarrhea and rapid death, but when this residue was reduced to 10%, most of the animals were gradually able to tolerate it. At the 4 or 7% level it was well tolerated, but growth was reduced. There were no distinctive histological lesions, and withdrawal of the polymer permitted immediate realimentation without evidence of subsequent injuries. The polymeric residue from autoxidized cottonseed oil exerted a greater growth-depressant effect than that from lard, and the latter, more than that from a hydrogenated vegetable oil used for deep-fat frying for 80 hrs. at 190° C. Addition of fresh fat to the polymeric residues decreased their growth-depressant effect.

Fats in the diet in relation to arteriosclerosis.

MAY, C. D. (State Univ. of Iowa). *J. Am. Med. Assoc., 162,* 1468-9 (1956).

Comments on fats in the diet based on a speech given at the Margarine All-Industry Conference in Virginia.

Fat, cholesterol, and atherosclerosis.

EAGLE, E., AND ROBINSON, H. E. (Swift and Co., Chicago, Ill.). *J. Am. Oil Chemists' Soc., 33,* 624-7 (1956).

A review. 70 references.

Graying of hair in rats fed a ration deficient in lysine.

VOHRA, P., AND KRATZER, F. H. (Univ. of California, Davis). *Science, 124,* 1145 (1956).

The coats of lysine-deficient black rats were very much lighter in color and finer in texture than the dark black and coarse hair coats of lysine-supplemented rats. It was concluded that lysine plays some role in the synthesis of melanin in the hair of rats.

Nutrition of the cat. 2. Protein requirements for growth of weanling kittens and young cats maintained on a mixed diet.

DICKINSON, C. D., AND SCOTT, P. P. (Royal Free Hosp. Sch. of Med., London). *Brit. J. Nutrition, 10,* 311-16 (1956).

It is concluded that with the type of mixed diet used growth of kittens is satisfactory only when the protein fraction exceeds 30% of the dry wt. This requirement is higher than those of other young animals investigated, with the exception of very young pigs.

Effect of vitamin D and Ca:P ratios on chick gastrointestinal tract.

GERSHOFF, S. N., AND HEGSTED, D. M. (Harvard Sch. of Public Health, Boston, Mass.). *Am. J. Physiol., 187,* 203-6 (1956).

The effect of feeding diets contg. various Ca:P ratios (4:1, 1:1, 1:2) to rachitic and nonrachitic chicks has been studied. The Ca:P ratios used had no significant effect on Ca absorption in chicks receiving vitamin D but were of importance in the Ca absorption of rachitic chicks.

The relationship between potassium utilization and nitrogen balance.

FRAZIER, L. E., HUGHES, R. H., AND CANNON, P. R. (Univ. of Chicago, Ill.). *Am. J. Clin. Nutrition, 4,* 655-61 (1956).

The administration of KCl to K-depleted animals while they were eating a N free ration failed to establish positive K balances or to promote wt. gains. The addn. to such rations of an appropriate amino acid mixt. caused the animals to go into positive N and K balances. These expts. emphasize the importance of body anabolism in relation to the overall utilization of dietary K.

Optimal nutrition correlated with nitrogen retention.

ALLISON, J. B. (Rutgers Univ., New Brunswick, N. J.). *Am. J. Clin. Nutrition, 4,* 662-71 (1956).

Experiments with rats and dogs indicate that the S amino acids are particularly effective in reducing the catabolism of tissue proteins and promoting anabolic processes. This may reflect in part the increased requirement of these amino acids in these hairy species. The liver, being a very labile tissue, makes it possible to correlate the nutritive value of dietary proteins with their ability to form labile liver proteins. This may also be expressed as the measure of liver enzyme activity under the influence of dietary protein. An adequate protein diet, especially one supplemented with vitamins, leads to the max. development of enzyme systems in the liver. Triethylene-phosphoramide

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(TEPA), depresses the growth of all body tissues. Supplementation of the diet with methionine under conditions of food restriction protects the carcass both from the depleting effect of the tumor and the drug.

Lactose as a lipotropic agent.

SADHU, D. P. (Bengal Vet. Coll., Calcutta, India). *Nature, 177,* 1236-7 (1956); *Dairy Sci. Abstr., 18,* 845 (1956).

Rats given a diet contg. 58% sucrose were pair-fed with animals given similar diets in which 10, 20, or 30% of the sucrose was replaced by lactose. After four wks. the rats were killed and their livers and kidneys analyzed for fat, choline, sphingomyelin and phospholipid. In both organs the concns. of choline and phospholipid increased, and of fat and sphingomyelin decreased as the lactose content of the diet increased. It is concluded that, under such controlled feeding conditions, lactose has a choline sparing and a lipotropic effect. A possible significance of this finding in connection with kwashiorkor is mentioned.

Some recent developments in oral feedings for optimal nutrition in burns.

ARTZ, C. P., SOROFF, H. S., PEARSON, E., AND HUMMEL, R. P. (Brooke Army Med. Center, Fort Sam Houston, Texas). *Am. J. Clin. Nutrition, 4,* 642-6 (1956).

The problem of nutrition in the severely burned patients seems to be prevention of protein depletion. Some type of high protein supplemental feedings is required because the patient is usually unable to take an adequate amt. of protein from the hospital tray.

Hypervitaminosis A. Experimental induction in the human subject.

HILLMAN, R. W. (State Univ. of N. Y., Coll. Med. at N. Y.C.). *Am. J. Clin. Nutrition, 4,* 603-8 (1956).

Hypervitaminosis A was induced experimentally in a normal human subject through ingestion of excessive quantities of this substance during periods of 14 and 25 days. The assocd. clinical picture resembled that of accidental vitamin A poisoning. The skin was most prominently affected. The plasma vitamin A concn. increased markedly, and appeared to be more closely correlated than the clinical picture with the quantity of vitamin A ingested.

A concept of optimal nutrition.

KREHL, W. A. (Yale Univ. Sch. of Med., New Haven, Conn.). *Am. J. Clin. Nutrition, 4,* 634-41 (1956).

Optimal nutrition was visualized as that which maintains a level of metabolic normalcy so that when the organism is exposed to stress, the normal protective homeostatic mechanisms can be put into operation rapidly, with a min. of strain, and for as short a time as possible. Because of this zone of homeostasis, it is difficult to establish the quantities of nutrients which provide optimal nutrition. These may vary considerably, depending upon individual biologic variability, sex, age, and both exogenous and endogenous stress.

PHARMACOLOGY AND TOXICOLOGY

A specific antidote against lethal alkyl phosphate intoxication. II. Antidotal properties.

KEWITZ, H., WILSON, I. B., AND NACHMANSOHN, D. (Columbia Univ., New York, N. Y.). *Arch. Biochem. and Biophys., 64,* 456-65 (1956).

The results described demonstrate that a powerful reactivator of acetylcholinesterase inhibited by alkyl phosphates, such as paraoxon and diisopropyl fluorophosphate, is an efficient antidote against lethal amts. of these compds. This fact strongly supports the view that the toxic effect of alkyl phosphates must be attributed essentially to a specific chem. reaction, i. e., the inactivation of acetylcholinesterase.

A study of the effects of certain lactones on digitoxin toxicity.

COSMIDES, G. J., MIYA, T. S., AND CARR, C. J. (Purdue Univ. Sch. of Pharmacy, Smith, Kline & French Labs., Philadelphia). *J. Pharmacol. Exptl. Therap., 118,* 286-95 (1956).

Tetrahydrofurfuryl alc. and butyrolactone protected chicken embryos from digitoxin toxicity. They also prolonged the time for A-V blockade to appear when perfused simultaneously with digitoxin in the frog heart. Results appear to support the theory that the unsatd. lactone of digitoxin is essential for cardiotonic activity and that a chemically related structure may compete for the same receptor to antagonize its action on the myocardium.

Toxicity of coumarin.

HAZLETON, L. W., TUSING, T. W., ZEITLIN, B. R., THIESSEN, R., AND MURER, H. K. (Gen. Foods Corp., Hoboken, N. J.) *J. Pharmacol. Exptl. Therap., 118,* 348-57 (1956).

The suitability of coumarin for sustained use as a flavor additive for foods and pharmaceuticals cannot be defined properly, on the basis of the acute and subacute toxicity studies reported.

PHYSIOLOGY AND MEDICINE

Some effects of ultrasonic energy upon blood coagulation.

AXELROD, S. L. (Harvard Med. Sch., Boston, Mass.). *J. Lab. Clin. Med., 48,* 690-701 (1956).

High-frequency sound waves provided an effective means of rapidly lysing platelets without altering the accelerator, antiheparin, or vasonconstrictor properties of the platelet constituents which were released. Suspensions of platelets, lysed by sonic energy, exhibited the same altered properties as did platelet suspensions lysed artificially by other techniques, namely: enhanced ability to accelerate plasma coagulation, and loss of the ability to promote syneresis.

Response potentials of vascular tissues and the genesis of arteriosclerosis—A review. Part II C. Hemodynamic factors.

BLUMENTHAL, H. T. (St. Louis, Mo.). *Geriatrics, 11,* 554-68 (1956).

A discussion of the hemodynamic factors and their relation to development of arteriosclerosis.

The practical application of the rapid intravenous glucose tolerance test in various disease states affecting glucose metabolism.

AMATUZIO, D. S., RAMES, E. D., AND NESBITT, S. (Univ. of Minnesota, Minneapolis). *J. Lab. Clin. Med., 48,* 714-20 (1956).

A simple and rapid test was demonstrated with use of the 25 g. rapid intravenous glucose tolerance test in the study of unexplained glycosuria. The variable factor of absorption of glucose from the alimentary tract was thus avoided.

The effects of intragastric injection of various substances on subsequent bar-pressing.

SMITH, MONCRIEFF, AND DUFFY, M. (Univ. Washington, Seattle). *J. Comp. Physiol. Psychol., 48,* 387-91 (1955); *Biol. Abstr., 30,* No. 30943 (1956).

Four expts. are reported, all dealing with the effects of intragastric injection (by stomach tube) on hunger, as measured by the subsequent rate of barpressing for a food reward. The results indicated that a fortified milk had a profoundly depressing effect on response rate, as did a 1*M* sucrose soln. Bulk alone (Kaolin) had no effect, nor did sugar alone (isotonic glucose). A 1*M* soln. of sorbitol had the same effect as a 1*M* soln. of glucose. A 1 *M* soln. of glycerol had an intermediate effect. The results are tentatively interpreted to indicate that a mechanical distention and a humoral change must act in conjunction to reduce hunger.

ENGINEERING AND PLANT EQUIPMENT

Continuous rotary filtration of corn gluten.

SCHEPMAN, B. A., MARTIN, B., AND DAHLSTROM, D. A. (Eimco Corp., Palatine, Ill.). *Chem. Eng. Progr., 52,* 423-7 (1956).

Investigations were made on the applications of continuous filtration to the dewatering of gluten and/or fiber. An analysis was also made of all the variables affecting filtration so that economic examinations of the entire process could be made. A continuous string discharge drum filter was employed.

New uses for ion exchange resins.

WHEATON, R. M. (Dow Chemical Co., Midland, Michigan). *Chem. Eng. Progr., 52,* 428-32 (1956).

Some of the newer novel ion exchange applications are discussed including ion exclusion and phenol-sorption.

Freeze-drying. II. A study of the factors governing the rate of freeze-drying of blood plasma.

KEARSEY, H. A., STRICKLAND-CONSTABLE, R. F., AND BRUCE, E. W. *Proc. Inst. Refrig., London, 50,* 69-89 (1953); *Food Sci. Abstr., 28,* No. 2108 (1956).

The evapn. of pure ice, and the evaporative drying of frozen clay and of frozen blood plasma were studied with the app. described, with a view to analyzing the factors governing the rate of drying in a com. plant for drying plasma. After a brief discussion of the laws governing the evapn. of pure ice, those governing the drying of frozen clay are summarized; the drying of clay was experimentally easier to study than that of plasma, and the laws governing this type of process were more easily established. Experimental results with plasma are given, and the application of the results to plant design is discussed.

FOOD AND FOOD TECHNOLOGY

CEREALS AND GRAINS

Hemicellulose components of rice.

BEVENUE, A., AND WILLIAMS, K. T. (U.S.D.A., Albany 10, Calif.). *J. Agr. Food Chem., 4,* 1014-17 (1956).

The hemicelluloses of California Pearl rice bran, rice polish, and polished rice, were quantitatively detd. and the isolated polysaccharides were examd. by paper chromatography. Rice grain hemicelluloses are composed chiefly of arabinose and xylose in a ratio of approx. 1:1, and contain small quantities of galactose, mannose, and uronic acid.

Structure of the mature wheat kernel. II. Microscopic structure of pericarp, seed coat, and other coverings of the endosperm and germ of hard red winter wheat.

BRADBURY, D., MACMASTERS, M. M., AND CULL, I. M. (Northern Utilization Research Branch, Peoria, Ill.). *Cereal Chem., 33,* 329-91 (1956).

There is no natural line of cleavage between bran and starchy endosperm, while germ is structurally a separate entity. A region of crushed and fragmentary thin-walled cells affords a pathway for quick movement of H_2O. The known macroscopic and microscopic kernel structure is thoroughly discussed and illustrated by numerous excellent pictures.

EMULSIFIERS AND STABILIZERS

Stabilization of fats in candy. II. The importance of free fatty acids.

ROBINSON, H. M. (Southern Regional Research Lab., New Orleans). *Mfg. Confectioner, 36* (9), 21-3 (1956).

The value of adding various antioxidants and glycerol to the fats incorporated in candies was investigated. The fats used included butter, hardened vegetable oil, com. animal fat shortenings, and hardened coconut oil. Candies contg. freshly churned butter had better keeping quality than those made with a high-score butter stored under refrigeration. Eleven antioxidants gave excellent protection against oxidative rancidity. The formation of free fatty acid was retarded by the addn. of glycerol but not by the addn. of antioxidants.

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FLAVOR AND FLAVORINGS

Enzymes and flavor.

JACOBS, M. B. *Am. Perfumer & Aromatics, 68* (4), 41-2 (1956).

A review article on the part enzymes play in the development of flavors in various foods. The use of flavorese enzyme for the improvement of flavor of processed foods is discussed.

Strawberry flavors.

JACOBS, M. B. *Am. Perfumer & Aromatics, 68* (3), 61-5 (1956).

Some suggested ingredients and formulae are given for prepn. of imitation strawberry flavor.

FRUITS AND VEGETABLES

Occurrence of a bitter principle in carrots.

DODSON, A., FUKUI, H. N., BALL, C. D., CAROLUS, R. L., AND SELL, H. M. (Michigan State Univ., East Lansing). *Science, 124,* 974-5 (1956).

Bitter carrots were dried and extd. with Me_2CO. Bitter crystals, which sepd. from soln. on removal of the Me_2CO, were recrystd. from aq. MeOH. Analytical data suggested that the compd. has the empirical formula of $C_{26}H_{28}O_8$. No compd. in the literature could be found which corresponded to the properties of the bitter compd. Bitterness in carrots is causing a considerable loss in vegetable producing states.

PECTIN

The binding of ions and detergents to pectin, protein and other colloid systems.

PETHICA, B. A. *Chemistry & Industry* (1956); 1046-8.

Due to the large amt. of information available on the binding of ions and detergents to proteins and on the relation of these phenomena to colloidal behavior, the author had taken the methods employed in the protein field as model methods for investigation of pectin.

PATENTS

Beer preservation.

Brit. 755,370, August 22, 1956.

Finished beer, particularly in containers, contg. the antibiotic thiolutin, and penicillin and/or polymyxin in amts. sufficient to inhibit microbiological contamination (e.g. $\leq 1.0\gamma$/ml. thiolutin and $\leq 0.02\gamma$/ml. penicillin and/or 0.5γ/ml. polymyxin).

Method of preparing a meat product.

SHADID, H. B. U. S. 2,771,366, November 20, 1956.

The method of prepg. a cohesive strip of ground meat product from lean beef and connective tissues, the method including the steps of grinding lean beef and connective tissues, chilling the ground meat product until the ground connective tissues turn gelatinous, regrinding the chilled meat product, compressing the meat product while providing the ground meat product with longitudinal serrations so as to interweave the fibers of the ground meat thereby forming a cohesive ground meat product.

(Continued from page 35)

Food & Drug Administration has approved the bottles as acceptable for use with steam-sterilized or non-sterilized products. The bottles can be attractively colored if desired. Continental's Plastic Container Division, at 2930 N. Ashland Ave., Chicago 13, will provide information on request.

A versatile new adhesive is being offered as a solution to difficult film-lamination problems. Known as Resyn 76-3963, it is a clear, amber-colored, synthetic rubber cement, said to be useful for bonding Pliofilm, Saran and polystyrene to foil, as well as Pliofilm to Saran, and also for adhering Mylar to Pliofilm or Saran. Resyn 76-3963 can be applied by reverse-roller or gravure coating prior to lamination. It is also said to be effective for a number of other laminating operations, including leather to metal. Specifications are available from National Adhesives Division, National Starch Products, Inc., 270 Madison Ave., New York 16.

. . . *the literary corner*

"Metal Foil: Wraps Up Bigger Markets," originally printed in *Iron Age* last November, is only one of many articles excerpted in *Reynolds Aluminum Digest*, vol. 5, no. 1. In addition, articles dealing with just about every application of aluminum are detailed in this issue. Copies can be obtained through Engineering Standards & Data, General Sales Office, 2500 S. Third St., Louisville 1, Ky.

In the new second edition of his *Chemistry and Technology of Waxes* (Reinhold, New York), IFT member Dr. A. H. Warth has included a special section on the use of wax in the food industry, as distinct from wax applications to paper materials largely used in packaging liquid and solid foods.

More than 4,000 chemicals manufactured and distributed by Matheson, Coleman & Bell, including fine organics, inorganic reagents, indicators and certified biological stains, are listed in the company's 1957 chemical catalog. Copies may be obtained by writing Matheson, Coleman & Bell, 2909 Highland, Norwood 12, Ohio, or East Rutherford, N. J.

Fritzsche Bros., Inc., believes that its new *Pharmaceutical Flavor Guide* is the first comprehensive listing of flavors developed for and adaptable to the requirements of modern pharmacy. With the new, 52-page book as a guide, anyone concerned with pharmaceutical formulations has a wide selection of flavoring materials to choose from. The 52-page book is indexed and cross-indexed, and copies can be obtained from Fritzsche Bros., Inc., 76 Ninth Ave., New York 11.

Two IFT members, Dr. Gordon Mackinney and Angela C. Little, both of the Department of Food Technology, University of California, Berkeley, have shown that the color of roasted coffee can be measured rapidly and with precision directly on a dry ground sample. Results of their research are given in Publication No. 17 of the Coffee Brewing Institute, 551 Fifth Ave., New York 17. The bulletin describes an accurate, instrument method for measuring the color of roasted and beverage coffees. The report is the first phase of a study being conducted to determine measurement of color as an indication of flavor formation.

Link-Belt Co., Prudential Plaza, Chicago 1, has published booklet No. 2454 to present the features of its LXS bushed roller chain. The chain is available in a wide range of sizes and designs for severe conveyor and power drive applications.

Recommended to every IFT member and reader of this journal is a new 36-page booklet published by Dodge & Olcott, Inc. Called "The Changing World of Food," it is an edited and up-dated reprint of a series of eleven articles that ran under the same title in the company's monthly publication, "D&O News." The articles offer a brief but comprehensive picture of the newer aspects of the food industry, and the part played by flavors and seasonings in this over-all picture. Copies can be obtained by writing the company, at 180 Varick St., New York 14.

A practical program for food plant sanitation is the subject of a new booklet published by Oakite Products, Inc. From the starting-point that sanitation is as much a part of processing as blending or retorting, the booklet presents a thorough discussion of in-plant cleaning and sanitizing. Mechanized methods of cleaning are described and illustrated, and a two-page chart lists equipment to be cleaned, detergents recommended, and methods to be used for the entire range of cleaning operations. Copies of the booklet, "A Coördinated Sanitation Program for Food Canning and Preserving Plants," are available from Oakite Products, Inc., 19 Rector St., New York 6.

. . . *the human element*

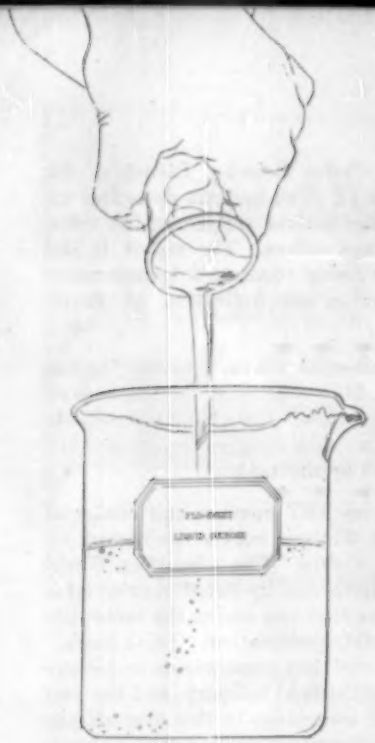
Russel Neville has been named to the sales department of Hobart J. Thurber Co., Chicago. For the past nine years, Mr. Neville has been with the bakery sales and service department of the Swansdown Flour Division of General Foods Corp.

L. A. Whitney Co., manufacturers' agent in packaging and processing equipment for the New England states, has moved to new quarters at 50 Kearney Rd., Needham, Mass. The company also has added **William A. White, Jr.**, to its sales engineering staff.

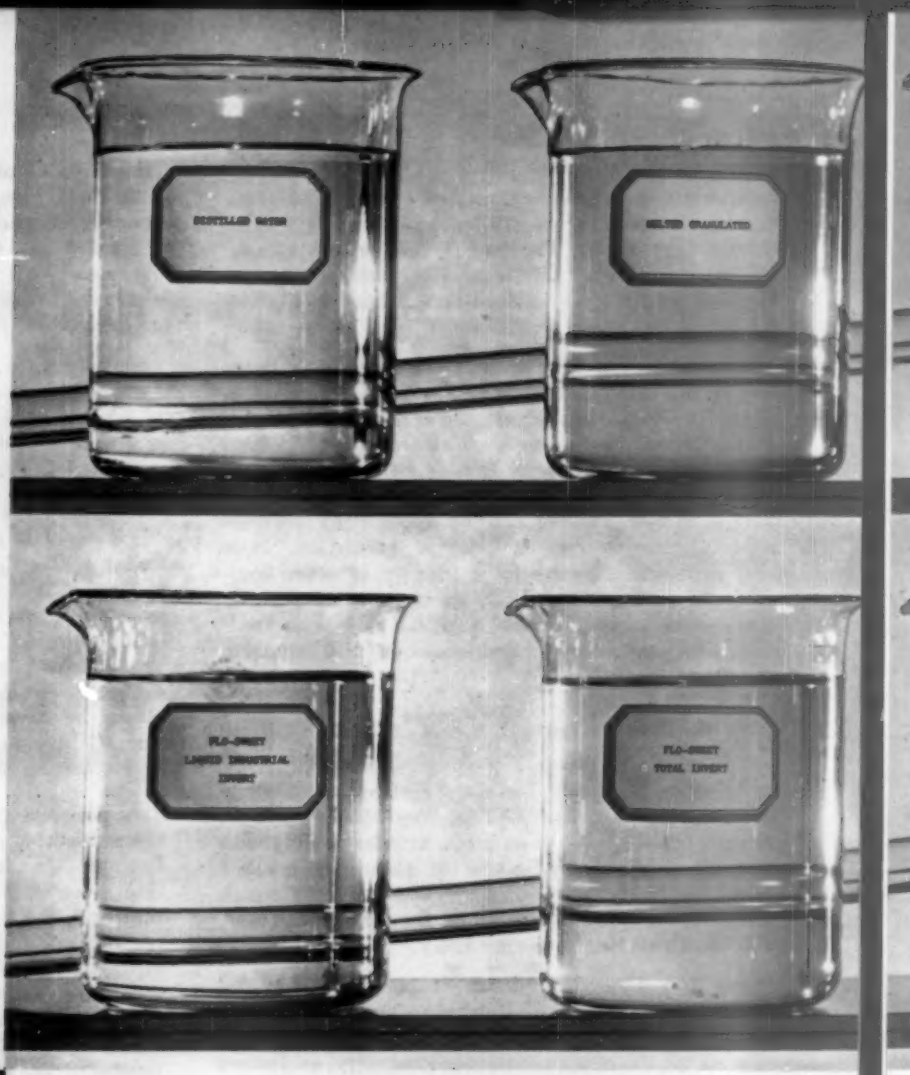
Dr. Herbert J. Dutton, research chemist for the U. S. Department of Agriculture, has won a first award of $1,000 and an honor plaque in the 1956 Glycerine Research Awards sponsored by the Glycerine Producers' Association.

Dr. Robert H. Cotton has been named to head the newly created starch and protein section of the Virginia Cellulose Division at Hercules Powder Com-

(Continued on page 46)



This color illustration is reproduced from an unretouched 8 x 10 Ektachrome original. The sample of melted granulated shows the color produced by a mixture of *three* commercial granulated sugars. To accentuate the colors for printing purposes, all samples were photographed in 1000-milliliter beakers; an idea of this size can be obtained from the typing on the labels. Below, a precision nephelometer is used to maintain frequent laboratory checks on Flo-Sweet's consistently lower turbidity—a further measure of refinery efficiency and liquid sugar quality.



IT'S CLEAR TO SEE...

See for yourself! This unretouched photograph reproduces the colors of the eight principal types of Flo-Sweet as precisely as possible with modern printing techniques.

Compare, if you will, Flo-Sweet liquid sucrose with distilled water. Hard to tell them apart, isn't it? Here's sugar quality you can *see!*

Note particularly the melted granulated, shown at the same concentration of sugar solids as the liquid sucrose. Compare it closely with Flo-Sweet industrial sucrose, industrial invert, total invert. Industrial types of Flo-Sweet show less color than granulated, the accepted standard of purity!

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(Continued from page 43)

pany's research center near Wilmington, Del. The new section was formed as a result of the recent acquisition of the Huron Milling Co. by Hercules. At the same time, the company announced that **Donald K. Dubois** has been named chief chemist at its Harbor Beach plant. Dr. Cotton formerly was with the Pennsylvania State Department of Horticulture and Pennsylvania State University; in a later post as director of the Plymouth, Fla., division of the National Research Corp., he organized work that led to the development of the first commercial frozen orange juice. An IFT member, Dr. Cotton joined Huron Milling in 1953. Mr. Dubois joined Huron Milling two years ago, and was responsible for research on the use of protein in the baking industry.

◆ ◆ ◆

Robert M. Schaffner and **Kenneth C. Hardwicke** have been promoted to new posts by Libby, McNeill & Libby. Mr. Schaffner, an IFT member, will serve as assistant to **John T. Knowles,** vice-president in charge of laboratories. He also has been named acting general superintendent of the eastern division, moving up from his former position of assistant general superintendent. Mr. Hardwicke has been named to the company's Seattle office, where he will become assistant to **Guy V. Graham,** vice-president in charge of salmon operations.

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CANADA

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Earl E. Davies is the new West Coast representative for Neumann-Buslee & Wolfe, Inc., Chicago. He formerly was Midwest sales and technical representative for National Aniline Division of Allied Chemical & Dye Corp. Mr. Davies will have his headquarters at 527 E. Union St., Pasadena 1, Calif.

◆ ◆ ◆

E. R. Brooks is the new vice-president in charge of production for the Atlanta Paper Co. A veteran of more than 21 years' service with the firm, Mr. Brooks first joined Atlanta Paper in 1935 as a machine operator. Most recently, as plant manager, he has been supervising production in three Atlanta plants.

◆ ◆ ◆

Robert Schwandt now is assistant superintendent in the dry starch department of A. E. Staley Mfg. Co., Decatur, Ill. Mr. Schwandt formerly was a chemical engineer in the company's development engineering section, and he helped plan and supervise installation of equipment in Staley's recently completed starch drier building.

◆ ◆ ◆

Richard J. Hale, an IFT member, recently was appointed to the Chicago flavor sales division of van Ameringen-Haebler, Inc. He will represent the company to food manufacturers throughout the midwestern area.

◆ ◆ ◆

Whitman Laboratories, Inc., Norwich, N. Y., has announced the election of **C. Nicholas Priaulx** as vice-president and treasurer and **John W. Farley** as vice-president and manager of the company's newly formed equipment division. The company also has appointed **P. C. Goodspeed, Jr.,** as sales engineer for the equipment division. Mr. Priaulx formerly was vice-president and treasurer of American Broadcasting Co. Mr. Goodspeed was with Lord Mfg. Co. and Sheffield Chemical Corp. prior to joining Whitman.

◆ ◆ ◆

William F. May is the new manager of manufacture for American Can Company's central division. Formerly general manager of the non-food division in the company's general sales department, Mr. May succeeds **R. F. Dickey,** who has been assigned special duties and will serve the company as a consultant.

◆ ◆ ◆

Joseph A. McGroarty is filling the newly created post of industrial accounts manager in the sales department of the Merck & Co. Chemical Division, Rahway, N. J. The company announced that its Chemical Division's expanding sales program to the meat packing, food and industrial chemical fields necessitated organizing the new department. Before leaving Merck for government work during the Korean War, Mr. McGroarty was manager of the Washington office of the Commercial Development Division, handling liaison work with various federal agencies.

◆ ◆ ◆

Benjamin C. Betner, Jr., formerly vice-president in charge of Continental Can Company's Shellmar-Betner Division, now is vice-president in charge of sales for the company's glass and plastics division. In an-

(Continued on page 48)

One look at the huge, sprawling buildings at one of the Exchange Products plants and you know that big things are happening inside. For here *citrus* is king. Trucks pour in with fresh fruit from groves all over California and Arizona. Conveyer belts hum along in every direction. And Exchange products are shipped to nearly every part of the world.

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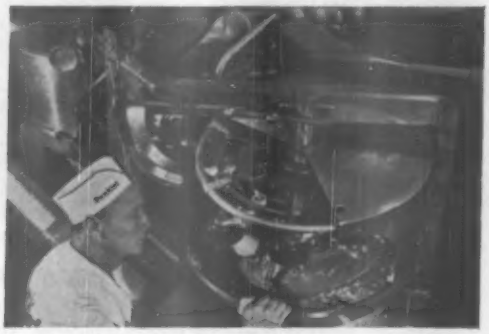

Utmost cleanliness is the watchword at Exchange Products plants. Everything has that "just washed-down" look. Every four hours, extraction equipment is completely cleaned. Every third day, the entire plant closes down for a thorough washing.

Exchange quality is assured by constant checking in extensive testing laboratories. In fact, rigid quality controls have been set up *throughout* the plant to make sure that every product measures up to Exchange quality. Sunkist produces more than 400 different citrus products.

The world's largest citrus research department is maintained by the Sunkist Growers to develop new growing methods, to improve manufacturing processes, and to perfect better products. Today, with a backlog of more than 60 years experience, Sunkist has accounted for 118 separate U.S. patents.

Just three of many Exchange products are *Exchange Preserver's Pectin*—guarantees a more uniform finished product; *Exchange Low Methoxyl Pectin*—jells *without* sugar, tasteless, controls "weeping" in pies; *Exchange Lemon Juice*—brings out natural flavor of *any* food. Superior acidulant, excellent anti-oxidant.

Sunkist Growers

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Exchange Lemon Products Co., Corona, Calif. • Exchange Orange Products Co., Ontario, Calif.

(Continued from page 46)

nouncing Mr. Betner's appointment, the company also announced that **Ray C. Schenk,** formerly control officer of Continental Can, has been named general manager of the Shellmar-Betner division.

◆ ◆ ◆

Roy Hagelin

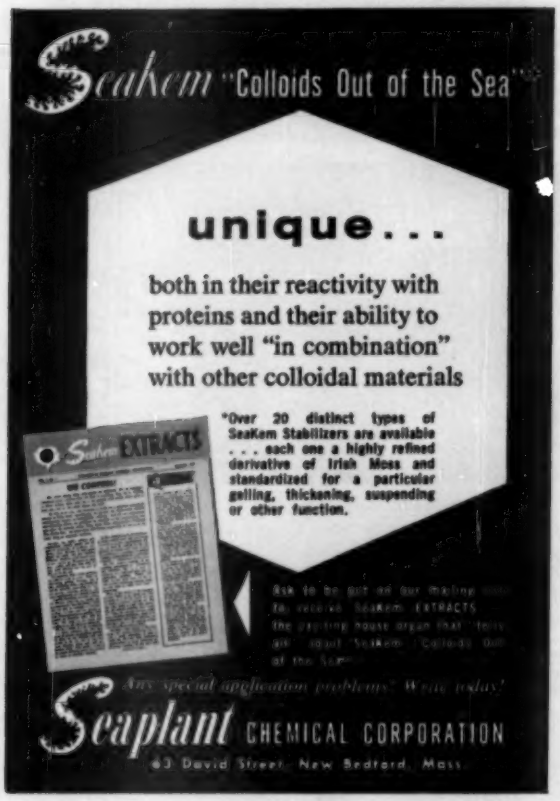
Roy Hagelin has been named as the new sales manager of Ungerer & Co., New York City. Mr. Hagelin has been working in the essential oils industry for more than 25 years, most recently as a staff member of Sunkist Growers, Inc., Ontario, Calif.

◆ ◆ ◆

Dewey H. Nelson, formerly assistant to the sales manager, has been promoted to sales manager of Becco Chemical Division of Food Machinery & Chemical Corp., Buffalo, N. Y. He succeeds the late John F. Shea, who was vice-president in charge of sales at the time of his death last November 26.

◆ ◆ ◆

Dr. Roy C. Newton, vice-president of Swift & Co., Chicago, has been selected unanimously to receive the 1957 gold medal of the American Institute of Chemists. The award is being given to Dr. Newton, an IFT member, in recognition of his leadership in food technology and his service to the profession.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John H. Nair of Thomas J. Lipton Co., president of the Institute and also an IFT member, has announced that the medal will be presented to Dr. Newton at the Institute's annual meeting, scheduled in Akron, Ohio, May 22-24. Dr. Newton has been an officer of Swift & Co. since 1941, and he has helped build there a research staff that has contributed hundreds of improved forms of food and food products. He is a past-president of IFT and former chairman of the Chicago section of the American Chemical Society. Probably the best known of Dr. Newton's research works, is his discovery and application of gum guaiac as an antioxidant in lard. He holds numerous awards and honors from technical and professional organizations, including the Nicholas Appert Award from the IFT.

◆ ◆ ◆

Fred C. Heinz, vice-president in charge of industrial relations for H. J. Heinz Co., has been appointed by President Eisenhower to the newly created water pollution control advisory board of the U. S. Public Health Service. Mr. Heinz formerly was president of the National Canners' Association and the Quartermaster Association. He currently is a director of the U. S. Chamber of Commerce.

Fred C. Heinz

◆ ◆ ◆

Three IFT members were appointed to important posts when DCA Food Industries, Inc., recently expanded its central research laboratories in New York City. They were **A. H. Goodman,** who is director of the food products development laboratory; **Walter Harte,** director of process engineering and development laboratory; and **Dr. Maynard Steinberg,** director of the fundamental research laboratory.

◆ ◆ ◆

H. L. Hartley

H. L. Hartley has been named Midwest representative for Henry H. Ottens Mfg. Co., Philadelphia. From headquarters in Minneapolis, Mr. Hartley will cover territory south to Kansas City and St. Louis, and from Chicago west to Omaha.

◆ ◆ ◆

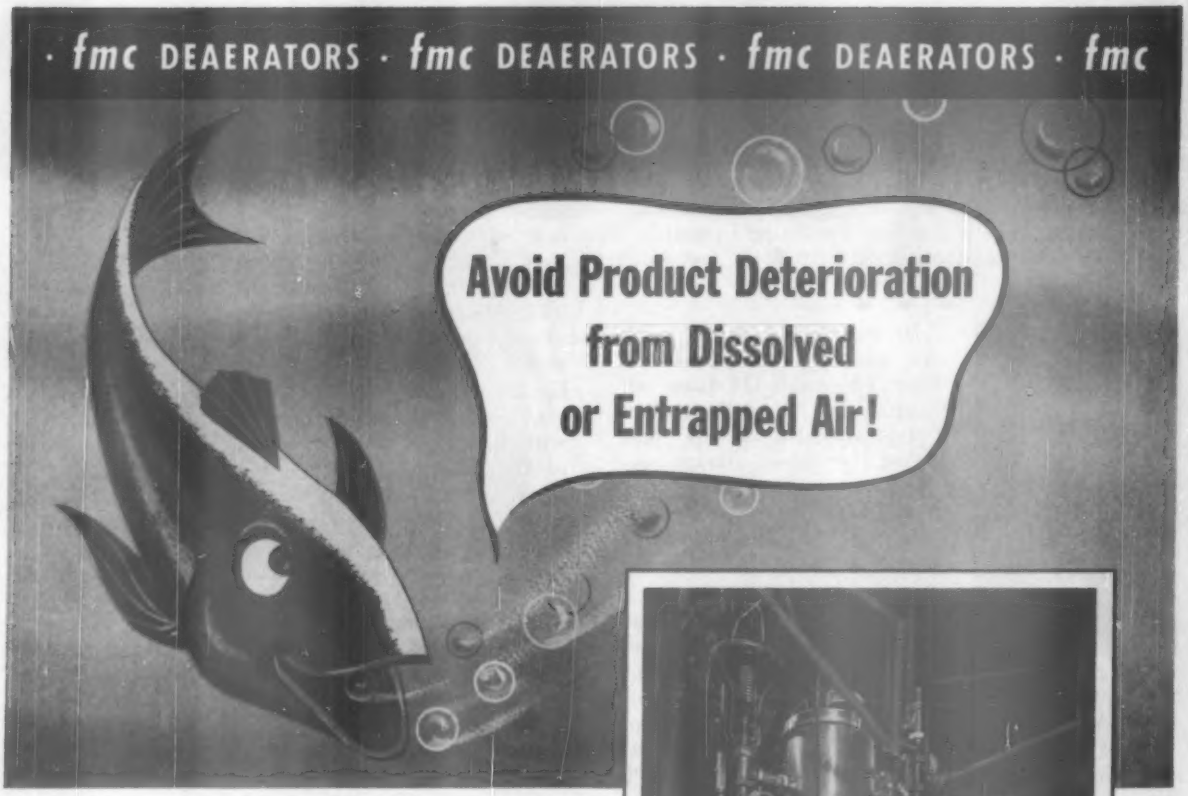
Allan J. Greene has been chosen to fill the newly created post of administrative vice-president and a member of the executive committee of Chas. Pfizer & Co., Brooklyn, N. Y. Mr. Green has been with Pfizer for 18 years and has been director of commercial development since 1954. He was named to the board of directors in 1955.

◆ ◆ ◆

Dr. L. J. Hayhurst of Kraft Foods Co., chairman of the food packaging committees of Packaging Institute and a member of IFT, recently announced for-

(Continued on page 50)

· fmc DEAERATORS · fmc DEAERATORS · fmc DEAERATORS · fmc



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FMC Deaerators have "saved the day" for scores of products. Those that have a greater tendency to entrap air bubbles or foam excessively are also susceptible to the harmful effects of oxidation within the container. Such products as tomato, grape, apple and orange juices, tomato catsup, table syrups and baby food are definitely improved in quality and appearance when deaerated by this efficient, economical FMC equipment. Vitamins are preserved, discoloration avoided and container corrosion retarded.

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(Continued from page 48)

mation of three important committees as part of Packaging Institute's technical activities. An Eastern Food Packaging Committee headed by **E. J. Monahan** of National Biscuit Co. and a West Coast group led by **C. Paul Bolton** of Carnation Co. both met in mid-January, while a Midwest Packaging Committee headed by **John Ramsbottom** of Swift & Co. met Jan. 31 in Chicago.

◆ ◆ ◆

Dr. F. T. Peters

Dr. Franklin T. Peters is the new assistant manager of the Fine Chemicals Division of Shulton, Inc., New York City. Previously, Dr. Peters had served in sales, market development and research positions with Du Pont, Glyco Products Co. and Heyden Chemical Corp.

◆ ◆ ◆

Dr. Frank P. Greenspan, formerly manager of organic research and development of the Becco Chemical Division of Food Machinery & Chemical Corp., has been appointed director of development for the new FMC Organic Chemicals Division. Dr. Greenspan, an IFT member, is an authority on the chemistry of hydrogen peroxide, peracids and organic peroxides. He has been with FMC's Becco division for the past ten years.

◆ ◆ ◆

Hatton B. Rogers

Hatton B. Rogers was recently appointed a vice-president of Dodge & Olcott, Inc., New York. Mr. Rogers joined D&O late in 1954 as director of its Dry Solubles Division. Previously, he had served as director of technical service for the Huron Milling Co., and for a number of years had worked with the research laboratories of the National Canners' Association and the Army Subsistence Research Program. Mr. Rogers will make his headquarters at the company's main offices at 180 Varick St., New York 14.

◆ ◆ ◆

S. V. Tuttas has been appointed director of sales for Crown Cork & Seal Co., and **William R. Fox** has been named to succeed Mr. Tuttas as manager of sales for the company's Crown & Closure Division. Mr. Fox formerly was manager of field sales for the division.

ACTUAL SIZE

New Combination Hand and Dipping Refractometer is Easy-To-Use, Accurate, Low-Cost.

The internationally known Goldberg combination Hand and Dipping Refractometer is easy to use... precise... and priced to meet limited budgets of fruit growers and fruit processors. It is designed for the rapid determination of the total soluble solids in juices, jams, jellies, syrups, solutions and other food products... Brix ranges 0 to 47% or 45-75%.

A unique optical system transmits a sharp transition line from light to dark onto a large .5% graduated scale in the focusable eyepiece. Metal parts are corrosion resistant... easy to clean... and protect optics from damage. Rugged, water-tight prism assembly permits immersion into solutions for dipping method... prevents seepage into the internal system... and allows convenient cleaning under running water.

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Alfred E. Southon, board chairman of Kalamazoo Vegetable Parchment Co., has been re-elected president of the Waxed Paper Merchandising Council and chairman of its board of directors. Also re-elected, as Council vice-president and vice-chairman of the board, was **George C. Wieman,** division sales administrator for Western-Waxide Packaging Specialty Division of Crown Zellerbach Corp.

Harold J. Green

Robert L. Zilligen

Harold J. Green, formerly sales service manager, has been appointed staff assistant to George W. Donald, general sales manager for the Western-Waxide Specialty Packaging Division of Crown Zellerbach Corp. Replacing Mr. Green as sales service manager is **Robert Zilligen,** formerly sales representative in the Chicago office.

Barbara Albert Russell, home economist, recently joined the psychometrics department of the United States Testing Co., Hoboken, N. J.

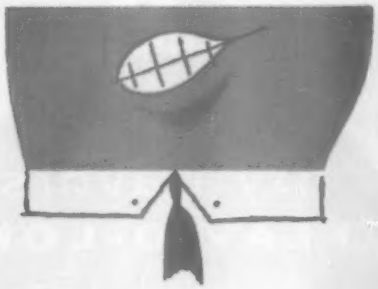
Edward F. Bouchard now is assistant director of the technical service department of Chas. Pfizer & Co., Brooklyn, N. Y.

W. D. Harrison

Ward D. Harrison, vice-president and general manager in charge of production for Riegel Paper Corp., New York City, has been elected president of the Technical Association of the Pulp & Paper Industry. Well-known in the papermaking industry, Mr. Harrison has been especially active in the fields of bleaching and semi-chemical pulping; he has headed various TAPPI committees and was elected vice-president of that organization in 1955.

Dr. Charles E. Brockway, formerly with B. F. Goodrich Co., has been named to head a research group at A. E. Staley Mfg. Co., Decatur, Ill.

Ralph C. Krueger is the new manager of converter sales for the Du Pont Company's Film Department. He succeeds Edward C. Lake, who died Feb. 9. Mr. Krueger has been associated with sales of Du Pont cellophane and other films since 1949, and was responsible for much of the early market development



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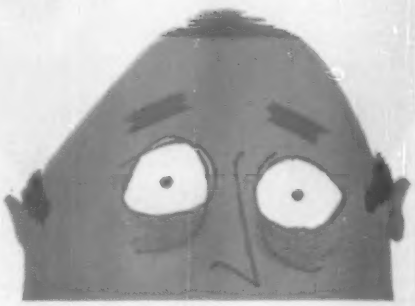

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Apple	Butterscotch	Punch
Strawberry	Methyl Salicylate	

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work that led to the introduction of Mylar polyester film in 1954.

◆ ◆ ◆

American Can Co. president **William C. Stolk** has been elected to his fifth consecutive term as a member of the National Industrial Conference Board.

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Bruce M. Bare has been appointed marketing manager of Atlas Chemical Company's Chemicals Division.

◆ ◆ ◆

Dr. James H. McGlumphy (left), vice-president of van Ameringen-Haebler, Inc., is shown with Philip De C. Kratz, who recently joined the technical and development staff of the company's Alva Flavors Division. Mr. Kratz, formerly of the research and control laboratories of Hoffman Beverage Co., is a past chairman of the New York Institute of Food Technologists and currently is one of the regional councilors of IFT. In his new post, Mr. Kratz will make his headquarters at the Alva Flavors laboratories in Elizabeth, N. J.

. . . *building up and branching out*

Morton Salt Co., Chicago, announced recently that it has reorganized the Scientific Salting Co., a Morton subsidiary, to form a new division known as the Scientific Dispensing Co. The new division will handle leasing, installation and servicing of salt tablet dispensers, bulk salters, Flocron liquid dispensers and other similar equipment. Morton will take over responsibility for the sale and distribution of salt tablets and bulk salt for the dispensers.

◆ ◆ ◆

In a move designed to take advantage of progress in metal container manufacturing, American Can Co. has formed a new machinery department to assume the responsibilities of its equipment division and closing-machine department. The new department will handle operation of the company's machine shops; development, design, sales and rentals of can-making and can-closing equipment; and technical service to customers. Operations will be headed by C. F. Lausten, former general manager of equipment in the general manufacturing department.

In another expansion move, American Can broke ground recently for its third Texas plant, a million-dollar, 115,000-square-foot factory at San Antonio

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that will produce up to 275,000,000 cans a year for beer and food products. F. B. Newcomb, recently elected vice-president in charge of central division operations, described the plant as one of the most modern of its type in the world. He said production should get underway later this year.

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Evans Research & Development Corp., independent chemical consulting laboratory in New York City, has added five members to its staff as part of a continuing program of expansion, according to Dr. Erie J. Hewitt, vice-president of the firm and an IFT member. Additions to the staff are cosmetologists Sylvia Fitzgerald and Frances Helen Eidam, and lab technicians Jose Martin Fernandez, Martin H. Prescott III, and Michael Argyros.

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Controlling interest in the Jefferson Island Salt Co., Louisville, Ky., has been acquired by Diamond Crystal Salt Co., St. Clair, Mich. Charles F. Moore, president and board chairman of Diamond Crystal, has indicated that Jefferson Island will be operated as an independent division. Jefferson Island's sales force and all office and factory employees, as well as the product line and brand names, will be retained. J. Lyle Bayless, Jr., Jefferson Island president, has been named a director of Diamond Crystal and a consultant on Jefferson Island product sales.

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Dole Hawaiian Pineapple Co. and Takamine Laboratory, division of Miles Laboratories, Inc., Clifton, N. J., have reached an agreement under which Takamine will handle industrial sales and market development of Dole's new proteolytic enzyme, bromelin. Takamine will use its sales staff of enzyme specialists to offer bromelin nationally to food, drug and beverage manufacturers.

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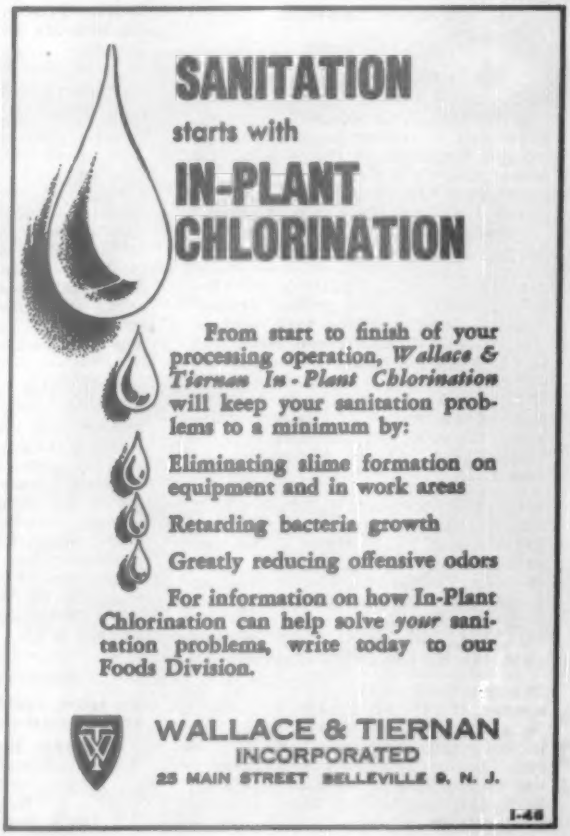
To better serve its West Coast clients, Food Research Laboratories, Inc., recently opened a western branch at 9331 Venice Blvd., Culver City, Calif. The company has set up a laboratory for nutritional, toxicological and pharmacological investigations; the new facility supplements the firm's more extensive laboratories in Long Island City, N. Y. Dr. B. H. Ershoff, nutritionist and biochemist who for many years was associated with the University of California, has been named to represent Food Research, Inc., in the new western office.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Architect's rendering shows $3,000,000 technical center planned by Atlas Powder Co. as part of a program to intensify its long-range basic research program. Located adjacent to the company's general office near Wilmington, Del., the new center is scheduled for completion by the end of this year, will offer facilities for work across the entire range of applications of Atlas products, including sorbitol, emulsifiers, detergents, polyester resins, activated carbons and explosives.

◆ ◆ ◆

Du Pont Co. recently announced plans for construction of a new chemical plant at its Carney's Point works in New Jersey. The new unit will manufacture refined as well as technical grades of Sodium CMC (sodium carboxymethylcellulose). Addition of the refined grades to Du Pont's Sodium CMC line will extend the range of industrial applications to the food, pharmaceutical and cosmetics industries.

◆ ◆ ◆

Through modernization and addition of equipment in its present plant at Niagara Falls, N. Y., the Industrial Chemical Division of Olin Mathieson Chemical Corp., Baltimore, plans a 25% increase in capacity for the manufacture of HTH high-test calcium hypochlorite. HTH is sold in various forms for laundry and textile bleaching, water purification, and sanitation purposes in dairies and food processing plants.

◆ ◆ ◆

Having outgrown its present facilities in Philadelphia, Automatic Temperature Control Co. is planning a midsummer move to a new plant now under construction at King of Prussia, Pa. The new building will provide 74,000 square feet of space for manufacturing, engineering and research, as well as general and administrative offices.

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WANTED: WOMAN JUNIOR TECHNOLOGIST—B.S. Home Economist with Experimental Foods Major. Work consists of new product development. Previous industrial experience preferred. Company located in Midwest. Submit complete resumé and salary requirements to BOX 531, Institute of Food Technologists, 176 W. Adams St., Chicago 3, Ill.

Bakery laboratory of large Company has opening in Products Control Department for a male graduate chemist. Experience in food analysis desirable but not necessary. Prefer applicants who presently live in or near New York City. REPLY BOX 526, Institute of Food Technologists, 176 W. Adams St., Chicago 3, Ill.

MICROBIOLOGIST AND FOOD TECHNOLOGIST: Applications are invited for positions of Microbiologist and Food Technologist. Applicants should possess a Bachelor's, Master's or Doctor's degree, and preference will be given to those whose training has involved publication of original research in the above or related disciplines such as biochemistry or organic chemistry. Send details regarding training, salary required, and references to: Fisheries Research Board of Canada, Director, Technological Station, 898 Richards Street, Vancouver 2, B. C., Canada.

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